NAVSHIPS 92363 CONFIDENTIAL

APR-9 tuners

INSTRUCTION BOOK

for

RADIO INTERFERENCE MEASURING SET AN/URM-42

STODDART AIRCRAFT RADIO CO., INC.
HOLLYWOOD 38, CALIFORNIA

NAVY DEPARTMENT BUREAU OF SHIPS

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NAVY DEPARTMENT BUREAU OF SHIPS

Contract: NObsr 63341 *Approved by BuShips: 20 October 1954*

DEPARTMENT OF THE NAVY
BUREAU OF SHIPS
WASHINGTON 25, D. C.

IN REPLY REFER TO
Code 993-100
20 October 1954

From: Chief, Bureau of Ships
To: All Activities concerned with the Installation, Operation and Maintenance of the Subject Equipment

Subj: Instruction Book for Radio Interference Measuring Set AN/URM-42, NAVSHIPS 92363

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RECORD OF CORRECTIONS MADE

CHANGE NO.	DATE	SIGNATURE OF OFFICER MAKING CORRECTION

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INSTALLATION RECORD

Contract Number NObsr-63341 Date of Contract 31 March 1953

Serial Number of equipment .....

Date of acceptance by the Navy .....

Date of delivery to contract destination .....

Date of completion of installation .....

Date placed in service .....

REPORT OF FAILURE

Report of failure of any part of this equipment, during its entire service life, shall be made to the Bureau of Ships in accordance with current regulations using form NAVSHIPS NBS 383 (revised) except for Marine Corps equipment, in which case the "Signal Equipment Failure Report" form shall be used and distributed in accordance with instructions pertaining thereto. The report shall cover all details of the failure and give the date of installation of the equipment. For procedure in reporting failures see Chapter 67 of the Bureau of Ships Manual or superseding instructions.

ORDERING PARTS

All requests or requisitions for replacement material should include the following data:

1. Federal stock number or, when ordering from a Marine Corps or Signal Corps supply depot, the Signal Corps stock number.
2. Name and short description of part.

If the appropriate stock number is not available the following shall be specified:

1. Equipment model or type designation, circuit symbol, and item number.
2. Name of part and complete description.
3. Manufacturer's designation.
4. Contractor's drawing and part number.
5. JAN or Navy type number.

DESTRUCTION OF ABANDONED MATERIAL IN THE COMBAT ZONE

In case it should become necessary to prevent the capture of this equipment, and when ordered to do so, DESTROY IT SO THAT NO PART OF IT CAN BE SALVAGED, RECOGNIZED, OR USED BY THE ENEMY. BURNS ALL PAPERS AND BOOKS.

Means:

1. Explosives, when provided.
2. Hammers, axes, sledges, machetes, or whatever heavy object is readily available.
3. Burning by means of incendiaries such as gasoline, oil, paper or wood.
4. Grenades and shots from available firearms.
5. Burying all debris, where possible and when time permits.
6. Throwing overboard or disposing of in streams or other bodies of water.

Procedure:

1. Obliterate all identifying marks. Destroy nameplates and circuit labels.
2. Demolish all panels, castings, switch and instrument boards.
3. Destroy all controls, switches, relays, connections and meters.
4. Rip out all wiring and cut interconnections of electrical equipment. Smash gas, oil, and water cooling systems in gas engine generators, etc.
5. Smash every electrical or mechanical part, whether rotating, moving or fixed.
6. Break up all operating instruments such as keys, phones, microphones, etc.
7. Destroy all classes of carrying cases, straps, containers, etc.
8. Bury or scatter all debris.

DESTROY EVERYTHING!

SAFETY NOTICE

The attention of officers and operating personnel is directed to Chapter 67 of the Bureau of Ships Manual or superseding instructions on the subject of radio-safety precautions to be observed.

This equipment employs voltage which are dangerous and may be fatal if contacted by operating personnel. Extreme caution should be exercised when working with the equipment.

While every practicable safety precaution has been incorporated in this equipment, the following rules must be strictly observed:

KEEP AWAY FROM LIVE CIRCUITS:

Operating personnel must at all times observe all safety regulations. Do not change tubes or make adjustments inside equipment with high voltage supply on. Under certain conditions dangerous potentials may exist in circuits with power controls in the off position due to charges retained by capacitors.

To avoid casualties always remove power and discharge and ground circuits prior to touching them.

DON'T SERVICE OR ADJUST ALONE:

Under no circumstances should any person reach within or enter the enclosure for the purpose of servicing or adjusting the equipment without the immediate presence or assistance of another person capable of rendering aid.

DON'T TAMPER WITH INTERLOCKS:

Do not depend upon door switches or interlocks for protection but always shut down motor generators or other power equipment. Under no circumstances should any access gate, door, or safety interlock switch be removed, short-circuited, or tampered with in any way, by other than authorized maintenance personnel, nor should reliance be placed upon the interlock switches for removing voltages from the equipment.

WARNING

NEVER MEASURE POTENTIALS IN EXCESS OF 1000 VOLTS BY MEANS OF FLEXIBLE TEST LEADS OR PROBES.

RESUSCITATION

AN APPROVED POSTER ILLUSTRATING THE RULES FOR RESUSCITATION BY THE PRONE PRESSURE METHOD SHALL BE PROMINENTLY DISPLAYED IN EACH RADIO, RADAR, OR SONAR ENCLOSURE. POSTERS MAY BE OBTAINED UPON REQUEST TO THE BUREAU OF MEDICINE AND SURGERY.

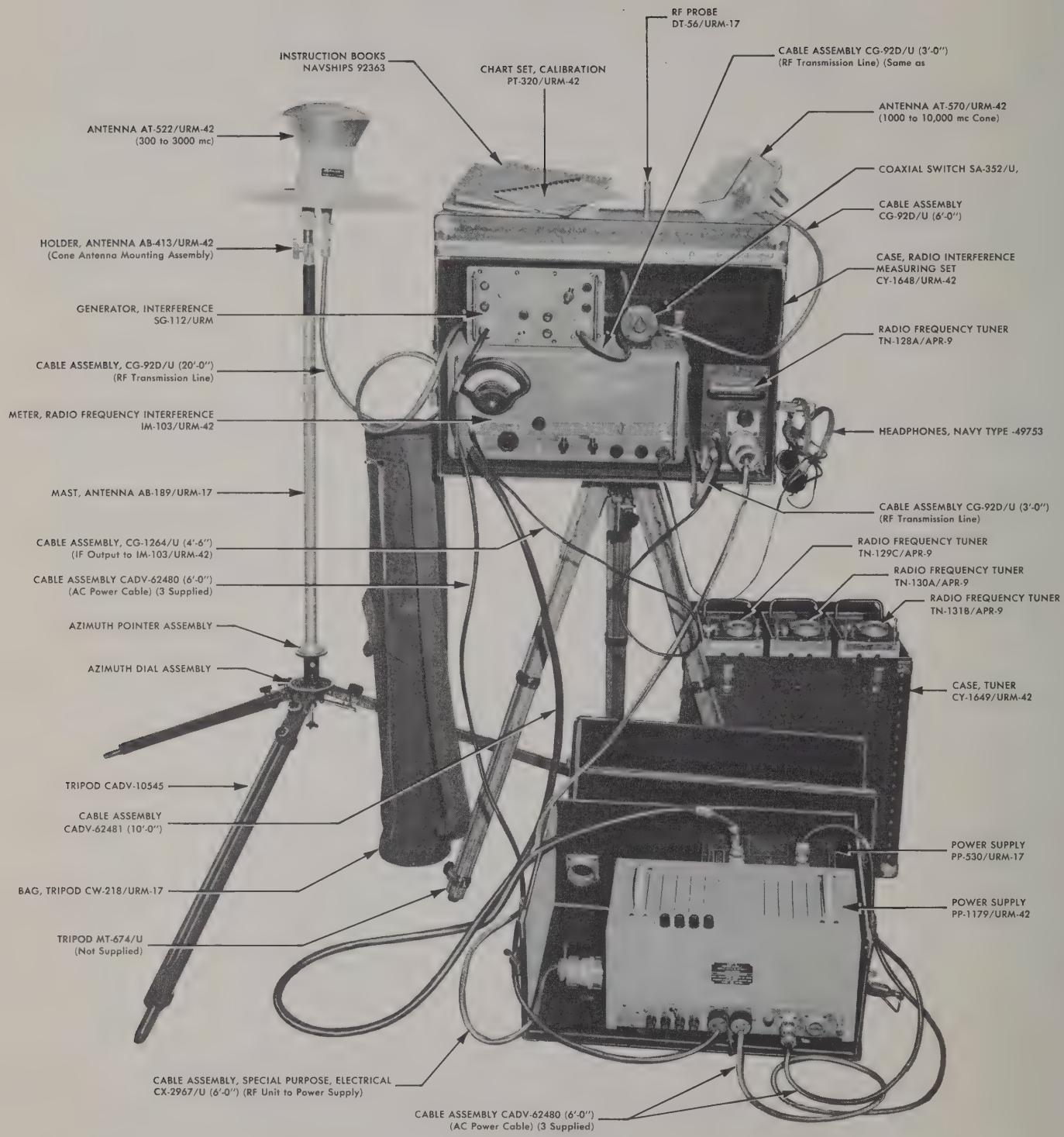

Figure 1-1, Radio Interference Measuring Set AN/URM-42, Relationship of Units

SECTION 1

GENERAL DESCRIPTION

1. SCOPE OF THIS MANUAL

This instruction book contains descriptive material, theory of operation, and instructions for the installation, operation, and maintenance of Radio Interference Measuring Set AN/URM-42, ultra- and super-high-frequency Radio Interference and Field Intensity measuring equipment. In addition, Section 6 of this manual contains a list of component parts.

2. PURPOSE AND BASIC PRINCIPLES

Radio Interference Measuring Set AN/URM-42 is designed for use in radio interference surveys to determine the source and magnitude of radiated interference from any source within its operating frequency range. Field intensity measurements can also be made with this equipment for the purpose of adjusting the radiation patterns of directive radio and radar antennas or in exploring the patterns of sources of spurious radiations. The test set can also be used as a sensitive radio-frequency microvoltmeter. It is suitable for operation aboard naval vessels, at shore stations, in the field, in aircraft, and in military vehicles.

NOTE

THE RADIO INTERFERENCE IM-103/URM-42 IS THE BASIC CONTROL AND METERING DEVICE OF RADIO INTERFERENCE MEASURING SET AN/URM-42. FOR CONCISENESS, THIS UNIT WILL HEREINAFTER BE REFERRED TO AS THE RI-FI METER.

Radio Interference Measuring Set AN/URM-42 consists of the basic RI-FI Meter together with four R-F Tuning Units, an Impulse Noise Generator, two separate power supplies, and a number of accessories which include a tripod, antennas, and the necessary cables to interconnect the various major units and accessories. (refer to table 1-1).

The RI-FI Meter, in conjunction with a selected R-F Tuner, constitutes a selective radio-frequency voltmeter over the 1000 to 10,750 mc portion of the radio-frequency spectrum.

Power supply requirements are a source of 105 to 125 volt, 50 to 400 cycle, a-c power. The equipment can be operated on a bench, table, or on the ground. The selected antenna is mounted on the tripod and connected to the input coaxial switch through a 20-foot length of 50-ohm coaxial cable. Signal monitoring provisions are available from panel-mounted headphone, remote meter, and oscilloscope receptacles. Measurements are made using the panel-mounted meter; however, approximate measurements can be made using a remote meter, oscilloscope, or graphic recorder.

Table 1-1, Equipment Supplied

QUANTITY PER EQUIP.	DESCRIPTION	NOMENCLATURE	STODDART PART/DWG.
1	Case, Radio Interference Measuring Set containing:	CY-1648/URM-42	90814-1
1	R-F Tuner (1.0 to 2.6 kmc/s)	TN-128A/APR-9	90817-1
1	Meter, Radio Interference - Field Intensity	IM-103/URM-42	90818-1
1	Generator, Interference	SG-112/URM	90819-1
1	Switch, Coaxial	SA-352/U	91121-1
1	Antenna (Small Cone)	AT-570/URM-42	90794-1
1	Antenna (Large Cone)	AT-522/URM-42	91029-1
1	Holder, Antenna	AB-413/URM-42	90795-1
1	Antenna Shield Assembly (Directional)	(part of Antenna AT-570/URM-42)	90803-1

Table 1-1, Equipment Supplied (Cont'd)

QUANTITY PER EQUIP.	DESCRIPTION	NOMENCLATURE	STODDART PART/DWG.
1	R-F Probe	DT-56/URM-17	90338-1
1	Headset	Navy Type-49753	G F E
3	Cable Assembly (6'0")	CADV-62480 (6'0")	90072-1
1	Cable Assembly (10'0")	CADV-62481 (10'0")	90082-1
1	R-F Cable Assembly (4'5")	CG-530/U(4'5")	90811-1
1	Cable Assembly (20'0")	CG-92D/U (20'0")	90933-5
2	Cable Assembly (3'0")	CG-92D/U (3'0")	90933-2
2	Chart Set	----------	-------
2	Instruction Book	NAVSHIPS 92363	-------
1	Case, Power Supply containing:	CY-1650/URM-42	91075-1
1	Power Supply (for R-F Tuner)	PP-1179/URM-42	90820-1
1	Power Supply (RI-FI Meter)	PP-530/URM-17	91057-1
1	Cable Assembly (6'0")	CX-2967/U (6'0")	90824-1
1	Case, Tuner containing:	CY-1649/URM-42	90826-1
1	R-F Tuner (2.3 to 4.45 kmc/s)	TN-129C/APR-9	90821-1
1	R-F Tuner (4.3 to 7.35 kmc/s)	TN-130A/APR-9	90822-1
1	R-F Tuner (7.05 to 10.75 kmc/s)	TN-131B/APR-9	90823-1
1	Bag Tripod, containing:	CW-218/URM-17	90407-1
1	Tripod	CADV-10545	90310-1
1	Antenna Mast	AB-189/URM-17	90318-2
1	Azimuth Dial Assembly	----------	90044-1
1	Azimuth Pointer Assembly	----------	90045-1

3. ELECTRICAL CHARACTERISTICS

a. Frequency Range:
1 to 10.75 kilomegacycles (with four tuning heads).

b. Type Receiver:
Double superhetrodyne.

c. Intermediate Frequencies:
160 megacycles and 60 megacycles.

d. Selectivity:
1.5-megacycle bandwidth at 6 db down points.

e. Image Rejection:
60 db or better.

f. Spurious Response Rejection:
60 db or better.

g. Intermediate Frequency Rejection:
60 db or better.

h. Sensitivity:

(1) As a Two-Terminal Voltmeter:
20 microvolts or better throughout frequency range of the equipment, based on signal to noise

ratio of unity.

(2) As a Field Intensity Meter:

400 to 4000 microvolts-per-meter depending on frequency, based on a signal to noise ratio of unity.

i. Signal to Noise Ratio:

Unity or better throughout the frequency range of the equipment, based on an equipment sensitivity of 20 microvolts as a two-terminal voltmeter.

j. Audio Channel Output:

100 milliwatts across 600 ohms, based on 1000 cycle, 30% modulation, and output meter indication of 10 microvolts.

k. Dynamic Range:

20 db in lower attenuation steps.

l. A-C Power Requirements:

(1) Voltage:

105 to 125 volts.

(2) Phase:

Single.

(3) Frequency:

50 to 400 cycles per second.

(4) Power Consumption:

375 watts.

SECTION 2

THEORY OF OPERATION

1. INTRODUCTION

Radio Interference Measuring Set AN/URM-42 can be used to measure the field intensity of radio transmissions or to measure the intensity of radiated or conducted radio interference. It can also be used as a sensitive selective r-f microvoltmeter within its frequency range.

Because the frequency spectrum of discontinuous interference can be extremely wide, the interference magnitude will depend upon the bandwidth of the measuring equipment. For impulsive interference, peak voltages are proportional to the bandwidth and average voltages are independent of the bandwidth. For random interference, both peak and average voltages are proportional to the square root of the bandwidth.

Bandwidth characteristics of the AN/URM-42 equipment are taken into consideration and are utilized in obtaining average, quasi-peak, and peak values of interference. Note follows:

NOTE

QUASI, MEANING SEEMINGLY OR PRACTICALLY, IS AN AVERAGING OF PEAK SIGNALS TO GIVE A FIGURE THAT IS RELATIVE TO THE AURAL NUISANCE VALUE, BECAUSE PEAK SIGNALS MAY HAVE A HIGH AMPLITUDE WITH STEEP WAVEFRONTS AND SHORT DURATION, THEY MAY HAVE A LOW AURAL NUISANCE VALUE.

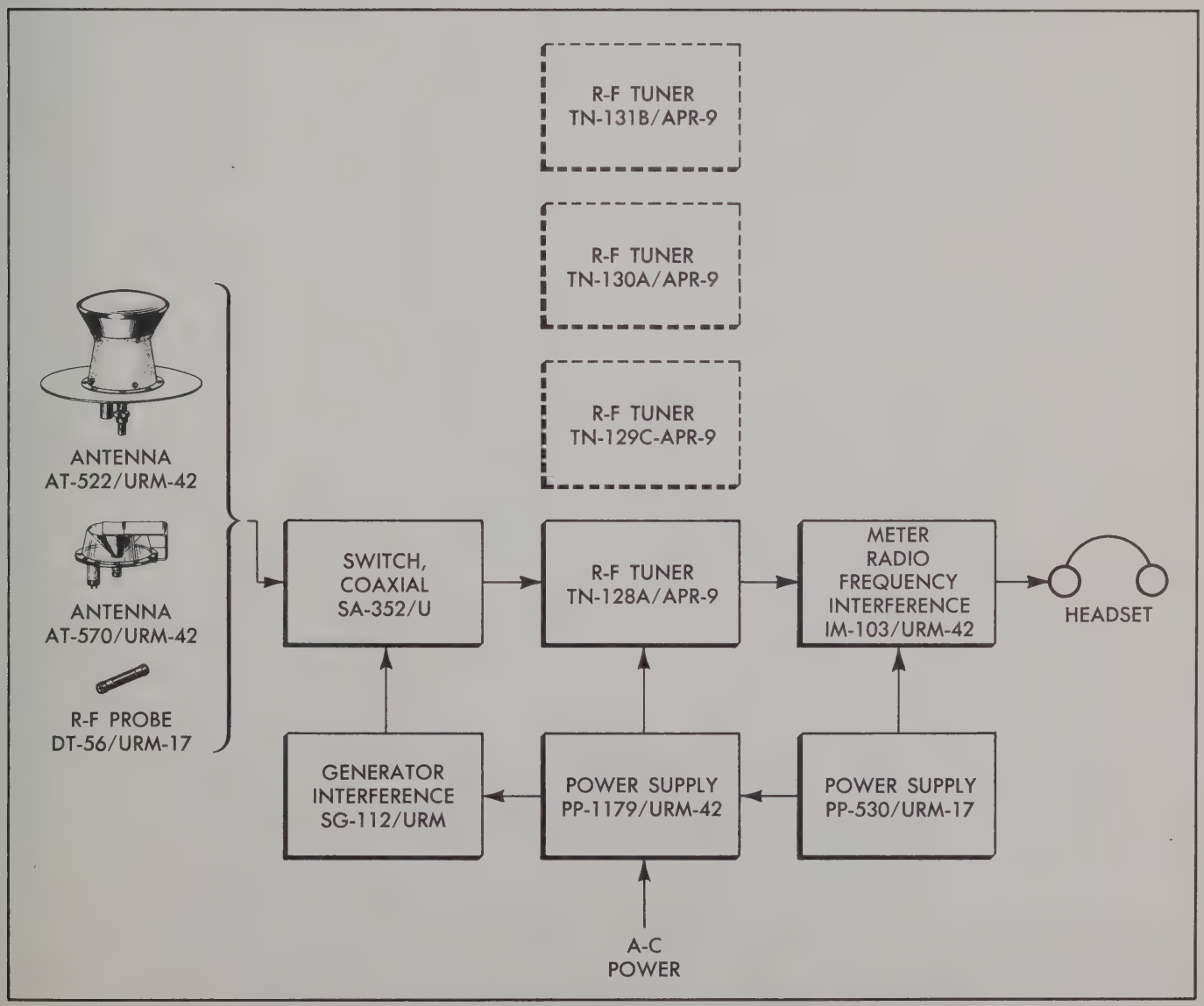

Figure 2-1, Radio Interference Measuring Set AN/URM-42 Block Diagram

2. GENERAL THEORY OF OPERATION

(See figure 2-1) The basic elements of the AN/URM-42 equipment are an R-F probe, two antennas, a Coaxial Input Switch, an Impulse Noise Generator, the RI-FI Meter, four R-F Tuners, and two power supplies, together with various accessories, such as cables, calibration charts, carrying cases, etc.

The input signal from the 20-foot r-f cable or from the impulse noise generator (SG-112/URM) is selected by the coaxial switch and applied to the input of the appropriate R-F Tuner. The R-F Tuner converts the input signal to a first intermediate-frequency of 160 megacycles and amplifies the signal to a level suitable for transmission to the RI-FI Meter. Power requirements of the R-F Tuner in use are met using a separate power supply. The RI-FI Meter converts the 160-mc input to the second i-f frequency of 60 megacycles, then amplifies the signal to a level sufficient to actuate the metering and audio circuits. The signal is then detected. The metering circuits provide accurate indications of field intensity and the audio circuits deliver audible samples of the signal to headphone jacks on the front of the RI-FI Meter to aid in tuning the R-F Tuner in use. Power to the RI-FI Meter is provided by a separate power supply, PP-530/URM-17. Generator, Interference SG-112/URM includes a self-contained power supply.

3. R-F TUNERS TN-128A/APR-9, TN-129C/APR-9, TN-130A/APR-9 AND TN-131B/APR-9

a. General:

Radio Interference Measuring Set AN/URM-42 is designed to operate with any one of the four R-F Tuners supplied. Except for the frequency range covered, each R-F Tuner performs the same function; however, the mechanical and electronic circuits may differ. The information contained in this section relative to the R-F Tuners is divided as follows: first, general information which is applicable to all of the tuners, concluded with a comparison chart noting the differences and similarities of major characteristics; second, an individual treatment of each R-F Tuner, with emphasis on the distinguishing characteristics of the R-F Tuner under discussion. The principal circuits of all four R-F Tuners are: an r-f preselector, a crystal mixer, a local oscillator, a mechanical tuning system, and i-f preamplifier, a reflector voltage network, and a filament voltage circuit. The R-F Tuners contain facilities for either local or remote tuning over any portion of the frequency range it covers; however, the automatic tuning features of the units are not utilized in the AN/URM-42. The term local tuning, as used in this publication, refers to the tuning of the R-F Tuners by means of the knobs on their front panels. Signals within a 20-mc bandwidth, centered at the frequency to which the R-F Tuner is tuned, are selected, filtered (from image, harmonic, and other spurious signals), and converted to signals centered at 160-mc (the first intermediate frequency). The 160-mc voltage is preamplified in order that the i-f output be at a level suitable for transmission by coaxial cable to the RI-FI Meter.

b. Block Diagram:

(See Figure 2-2.) A block diagram of the R-F Tuners is shown in figure 2-2. Signals from the antenna in use are fed through coaxial cable to the input of the r-f preselector. This preselector, essentially a tunable bandpass filter, consists of three overcoupled tuned circuits of the coaxial cavity type. Image and other spurious signals are, in general, attenuated at least 60 db. After passing through the preselector, the signal is channeled to the crystal mixer. Voltage from the local oscillator is fed through a matching and padding section to the mixer, where it is applied to the crystal, in parallel with the signal voltage. The reflex klystron local oscillator tracks with the preselector through a mechanical drive system so that, at any point in the frequency range, the frequency of the local oscillator is either 160-mc higher or 160-mc lower than the indicated signal frequency, depending on which R-F Tuner is in use. The 160-mc intermediate frequency generated by the mixer is fed directly to the first stage of the i-f preamplifier. The i-f preamplifier consists of four JAN-6AK5 tubes, of which three are arranged as a stagger-tuned triple. The remaining JAN-6AK5 tube provides impedance transformation at the preamplifier output to match the output to the nominal impedance of the coaxial line which transfers the i-f output to a connector located on the front panel of the R-F Tuner. The i-f output is then transmitted through coaxial cable to the RI-FI Meter. The R-F Tuner contains a mechanical drive system which, in addition to tracking the tuning of the local oscillator with that of the preselector cavities, controls two potentiometers, one of which varies the reflector-to-cathode voltage of the reflex klystron as a function of tuning, while the other supplies voltage to an automatic sector-sweep tuning circuit which is not utilized in Radio Interference Measuring Set AN/URM-42. The mechanical system also includes a frequency-indicating counter and a synchro-generator which is capable of repeating the frequency reading at some remote location, although provision for this connection is not made in the AN/URM-42. The 28-volt tuning motor, which normally permits remote electrical tuning, is disengaged by an automatic clutch control that is operated by the placement of the knob on the manual tuning shaft.

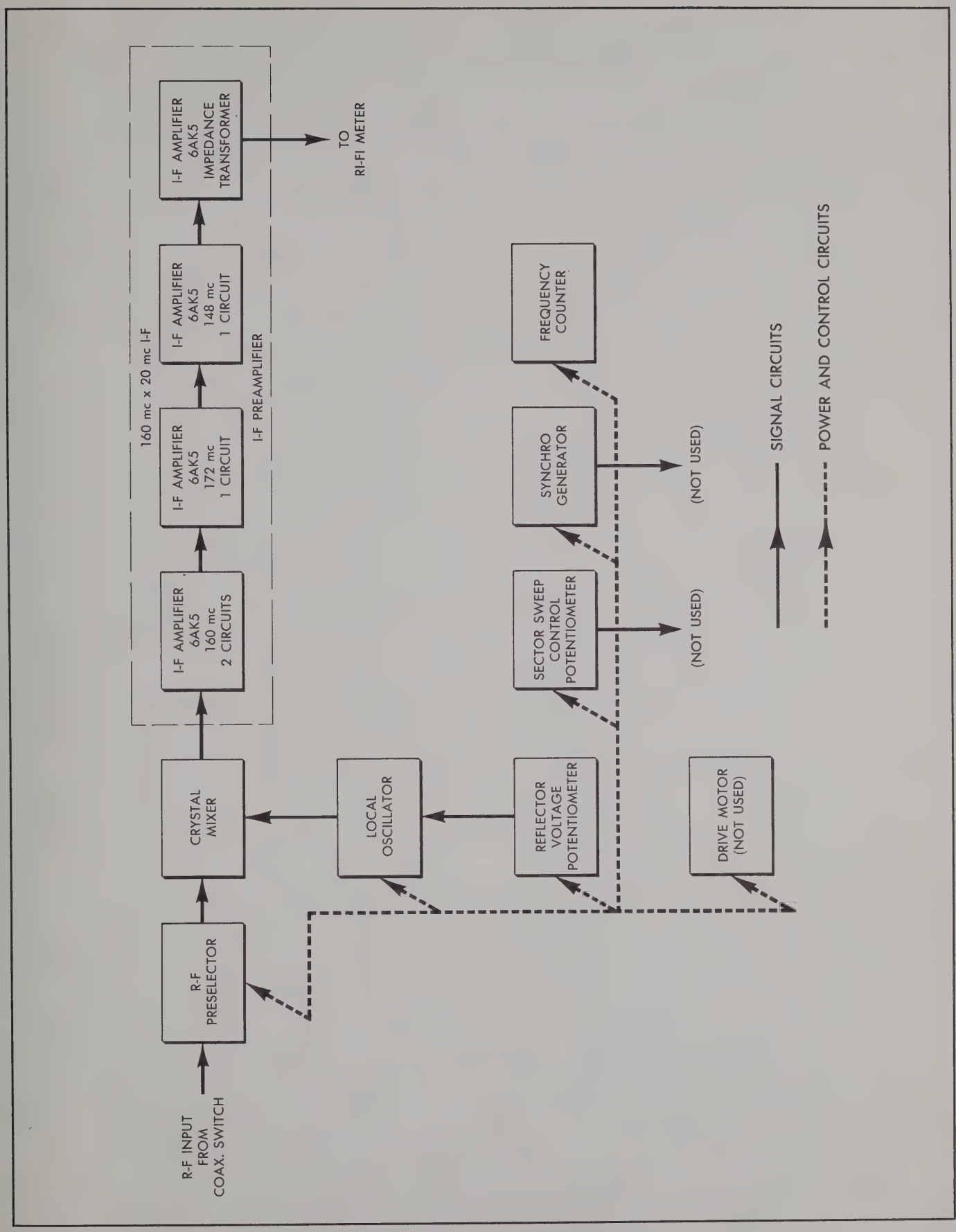

Figure 2-2, R-F Tuners, Block Diagram

Since the knob is always in place, the clutch is always operated, and the automatic tuning motor is permanently disengaged. Furthermore, 28-volt power is not provided for excitation of the motor.

c. R-F Preselector:

(1) General:

In order to obtain suitable selectivity over the 20-mc pass band of the tuner, and to effectively reduce image and other spurious signals, a tunable bandpass filter, or preselector, which tracks over the entire frequency range covered, is included in the r-f input circuit of the R-F Tuner. The frequency response curves shown in Figure 2-3 for R-F Tuner TN-129C/APR-9 are typical for all four R-F Tuners. The response of the coupled-circuit preselector is a function of the number of resonant circuits involved and the degree of coupling. Since the degree of coupling determines the bandwidth, the number of resonant circuits is determined from the bandwidth and the desired rejection of spurious signals. In all the R-F Tuners, for the respective i-f bandwidth, three over-coupled circuits are used which, in general, provide an image rejection of greater than 60 db. The coupled circuits are coaxial cavities coupled by means of apertures between cavities. In order to achieve adequate coupling by means of apertures, the cavities of TN-128A/APR-9 and TN-129C/APR-9 are square while the cavities of the remaining two tuners are circular. The cavities operate in the one-quarter wavelength mode in the TN-128A/APR-9 and TN-129C/APR-9 and in the three-quarter wavelength mode in the TN-130A/APR-9 and TN-131B/APR-9. The cavities are tuned to the desired electrical length by axial movement of the center conductors. Cavity dimensions are small enough to prevent setting up higher order circumferential modes, yet large enough to obtain proper coupling through apertures. To elimate the problems associated with sliding metallic contacts (tuning noise, erratic contacts, friction, and wear), a noncontacting short circuit to the center conductor is provided at the end of each cavity. Separate ball bearing guides are used to support each center conductor, keeping it concentric within the contacting element.

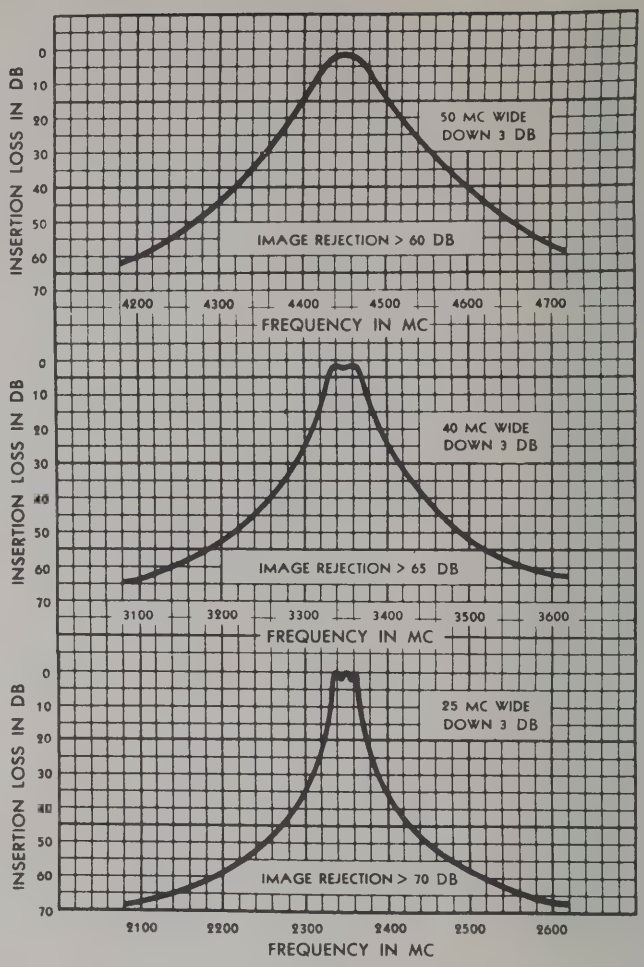

Figure 2-3, R-F Tuner TN-129C/APR-9, R-F Preselector Frequency Response Curves

(2) Noncontacting Short-circuiting Elements:

(See Figure 2-5). The noncontacting short-circuiting elements use a compound line to provide a low impedance to the center conductor at the end of each cavity. The compound line, shown schematically in Figure 2-4, consists of a section of coaxial line Z_I which has a very low characteristic impedance followed by a series-connected short-circuited section of coaxial line Z_2 with a high characteristic impedance. The compound

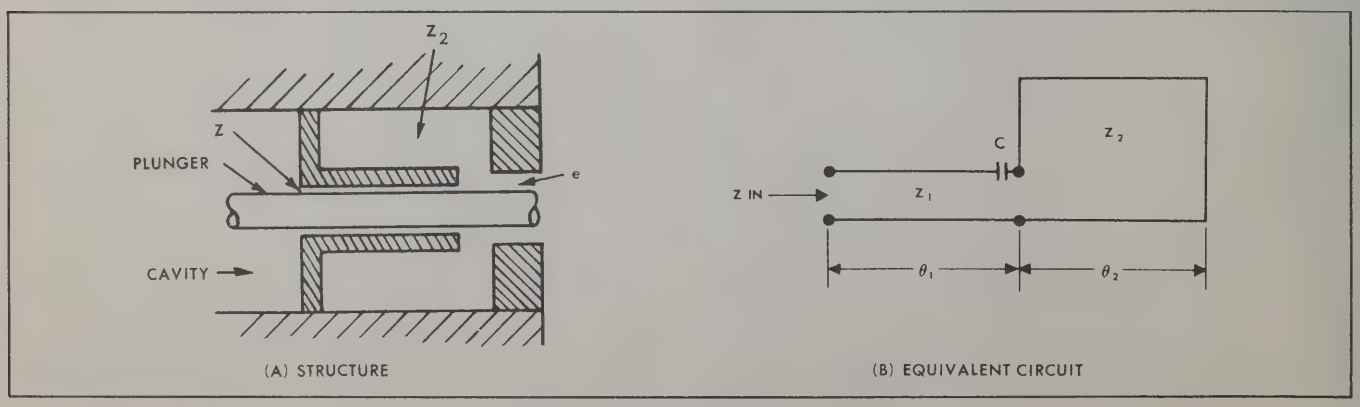

Figure 2-4, Compound Line

line presents a low input reactance over a wide frequency range when each coaxial section is approximately one-quarter wavelength long at the mid-frequency and when the ratio of the characteristic impedance of the two sections is made as large as possible. A low input resistance is presented when the characteristic impedance of the low-impedance section is made as small as possible and when the electrical length of each section is designed to vary from about 45 degrees to about 90 degrees over the frequency range. In the preselector, the compound line is constructed so that the short-circuited section is folded back over the low-impedance section. The low-impedance section of the compound line is the coaxial line formed by the plunger passing through the small clearance hole in the end fitting; the high-impedance section is the folded-back recess. The series-capacitance shown in Figure 2-4, at the junction of the low- and high-impedance sections, occurs between the center conductor and the grounded guide supports. The spacing between the inner and outer conductors in the low-impedance section is about 0.006 inch, giving a characteristic impedance of approximately 2 ohms. The characteristic impedance of the short-circuited section is approximately 35 ohms. Tuning noise is eliminated by the isolation provided by the compound line between the cavities and plunger supporting bearings.

(3) Coupling:

Aperture-type coupling is used in the preselector because an aperture can be designed to have a low self-reactance and to be flush with the cavity wall, thus producing the minimum effect on the field and, therefore, on the tuning of the cavity. Transverse slots located between the cavities are the interstage coupling apertures. The interstage coupling is the main factor that determines the bandwidth of the preselector. The terminating coupling is the main factor that determines the loading on the cavities and the shape of the response curve within the pass band. The terminating couplings are designed to keep the response within the pass band flat within 3 db throughout the tuning range.

(4) Losses:

The losses in the preselector are caused by mismatch and by dissipation. Satisfactory wide-band matching at the input and the output is obtained by making the size of the couplers such as to give the desired loading throughout the range, and by connecting them by means of tapered coaxial sections to the antenna cable and directly to the crystal mixer. In order to keep the dissipation loss in the pass band low, the internal losses in the cavities are made a small fraction of the external losses coupled into them by the input and output terminations; i.e., the unloaded Q of each cavity is much greater than the loaded Q of the cavity. In the preselector an unloaded Q of greater than 2500 for each cavity keeps the total dissipation loss under 1 db. Throughout the range, the loss, due to all causes, varies from 0.5 to 4.0 db, and the rejection of all spurious signals is, in general, at least 60 db.

d. Crystal Mixer:

The function of the crystal mixer is to convert the r-f signal from the preselector to a lower frequency which can be more easily amplified. This function is accomplished by combining the r-f signal from the preselector with the local oscillator signal in a silicon crystal. Because the impedance of the crystal is nonlinear, an i-f output voltage is produced which is fed to the i-f preamplifier. The crystal mixer is secured to the end of the i-f preamplifier, and the assembly is mounted on the side of the r-f preselector. The crystal is held in place by spring finger contacts. For shielding purposes, the crystal is located behind a screw-on cap. The r-f signal from the preselector is coupled to the crystal through a circular terminating aperture built into the base of the mixer. Since the diameter of the aperture is considerably larger than that of the crystal, a short, tapered section of coaxial line is used to connect the aperture to the crystal. Power from the local oscillator is fed to the crystal in parallel with the r-f signal through a 50-ohm cable.

e. Local Oscillator:

(1) General:

The local oscillator uses a reflex klystron tube with a coaxial cavity resonator external to the tube. The oscillator tunes continuously over the frequency range covered by the R-F Tuner either 160-mc below or 160-mc above the r-f signal frequency, depending on the R-F Tuner in use. The cavity resonator is tuned by means of a non-contacting short-circuiting plunger. The reflector-to-cathode voltage of the reflex klystron is continuously varied with tuning, and it tracks with the movement of the short-circuiting plunger through a mechancial tuning system. For safety in handling, the klystron resonator is grounded and the cathode operates at a negative potential. Power is extracted from the cavity resonator by loop or probe coupling at a fixed point in the cavity and is delivered to the mixer.

(2) Coaxial Cavity Resonator:

The local oscillator cavity operates in the TEM (transverse electromagnetic) mode. This is the usual wave mode existing in ordinary coaxial transmission lines and is characterized by the fact that the electric and magnetic vectors are both at right angles to the direction of wave propagation. A short-circuited coaxial cavity is resonant when it is an odd number of quarter wavelengths long. The reason a cavity oscillates in the 3/4-wave-

length mode, instead of the 1/4- or 5/4-wavelength mode, for example, is that the reflector voltage is maintained at values proper for oscillation at the frequency corresponding to a 3/4-wavelength cavity length. There are several possible values of reflector voltage suitable for oscillation at a given frequency, as indicated by the reflector transit mode characteristics of a klystron tube. Suppose that the 2-3/4 mode is to be utilized. This means that, on the average, electrons take the time of 2-3/4 cycles, at the oscillator frequency, between their first and second passages through the resonator grids. For an oscillator to tune continuously over a wide range of frequencies, it is necessary that the reflector voltage be so tracked with the tuning as to remain at all times within the chosen reflector mode limits. Where the length of a cavity resonator is a 3/4-wavelength at the operating frequency and the 3-3/4 reflector mode of the tube is utilized (as is the case in R-F Tuner TN-131B/APR-9), it would be possible, in a simple cylindrical cavity, at certain tuning positions and reflector voltages, for the tube also to oscillate at a frequency corresponding to a 1/4-wavelength cavity mode, with a 1-3/4-cycle reflector transit time. To prevent the occurrence of this second, undesired oscillation, a mode suppressor is necessary. This mode suppressor is described in paragraph 2-3N(4)(c). In other instances, as in the TN-130A/URM-42, simultaneous oscillation can occur at two frequencies due to the operating characteristics of the reflex klystron. The undesired oscillation, in this case, is prevented by means of waveguide traps loaded with lossy material.

The end of the cavity opposite the tube is short-circuited by a special type of plunger which, to avoid wear and consequent tuning noise during continuous tuning, does not make mechanical contact either with the cavity walls or with the cavity center conductor. (See Figure 2-5.) A plunger of this type, made up of resonant line sections of the proper lengths, has the characteristic of producing a very low impedance across the small air gap between the plunger and the cavity wall and also across the air gap between the plunger and the center conductor. Therefore, it electrically short-circuits the cavity at a position very close to the front face of the plunger. It is similar in principle to the composite line short circuit used in the preselector (see Figure 2-4) except that it short-circuits two gaps instead of one and has two low-impedance and two high-impedance line sections. Both high-impedance line sections are folded into the interior of the plunger; the low-impedance sections are in the gaps between the cavity center conductor and plunger, and between the plunger and cavity outer wall.

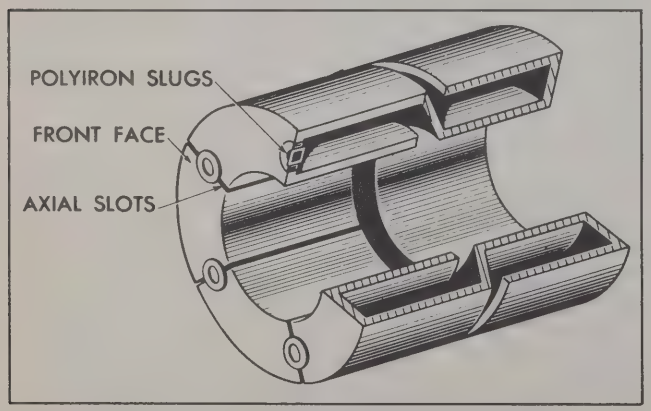

Figure 2-5, Noncontacting Short-circuiting Tuning Plunger

(3) Oscillator Output Coupling:

The coupling system of the R-F Tuner, used to extract power from the local oscillator consists of a small loop or probe (depending on the R-F Tuner in use), fixed in position and located just inside the outer conductor, near the tube end of the cavity. The coupling loop is oriented in its optimum position for coupling to the electromagnetic field in the resonator; the axis of the cavity lies in the plane of the loop. Its position is such that a satisfactory value of crystal current is obtained throughout the tuning range. Its longitudinal position along the cavity is chosen so that it will remain as nearly as possible in a region of constant field as the plunger position (and frequency) is varied. The penetration of the loop or probe into the cavity is adjustable using stop nuts, and is secured with a locking set screw to permit choosing optimum coupling for the reflex klystron in use.

f. Mechanical Tuning System:

NOTE

THE MECHANICAL AND CERTAIN ELECTRICAL PORTIONS OF THE R-F TUNERS' TUNING SYSTEMS, AS DESIGNED, INCLUDES FACILITIES WHICH PERMIT THEIR APPLICATION TO MORE EXTENSIVE SYSTEMS THAN THAT OF THE AN/URM-42. THESE FACILITIES INCLUDE AUTOMATIC TUNING FROM A REMOTE LOCATION AND REMOTE SECTOR SWEEP AND FREQUENCY INDICATIONS. THESE CIRCUITS AND PROVISIONS ARE NOT UTILIZED IN THE AN/URM-42; HOWEVER, DUE TO THEIR EXISTENCE IN THE R-F TUNERS, AS INSTALLED IN THIS EQUIPMENT, THEIR EXISTENCE IS TAKEN NOTE OF AND DISCUSSED BRIEFLY WHEREVER APPROPRIATE IN THIS INSTRUCTION BOOK.

The mechanical tuning system of the R-F Tuner provides a means of manually tuning the unit from the front panel; in addition, an automatic, sector-sweep tuning circuit is included, although not used. Provision is also made for indicating the frequency to which the unit is tuned at some remote station; this circuit is not utilized in the AN/URM-42.

These functions are achieved through suitable gears and cams which gang the tuning of the local oscillator, r-f, preselctor, reflector voltage potentiometer, sector-sweep potentiometer, synchro generator, frequency-indicating counter, and tuning motor. In the AN/URM-42, the unit is limited to local tuning from a front panel control. This knob, when on its shaft, displaces a hub which, in turn, disengages the drive motor shaft from the tuning linkage through a clutch mechanism. The front panel end of the tuning shaft is geared to the synchro generator and counter. The rear of the shaft is geared to two potentiometers through a large gear, which is also coupled to two limit switches. Mechanical stops on this gear prevent overtravel. A worm thread on the tuning shaft tunes the worm gear which actuates the tuning cams. A heat-sensitive compensating unit is installed in all four R-F Tuners to maintain the oscillator frequency in proper relation to the preselector tuning frequency.

g. I-F Preamplifier:

The i-f preamplifier of the R-F Tuner receives signals from the mixer and amplifies them to such a level that they may be transmitted through coaxial cable to the RI-FI Meter without introducing additional noise. The preamplifier amplifies signals in a band 20-mc wide, centered at 160-mc. The circuit contains four 6AK5 tubes. Three tubes act as amplifiers and the fourth as an impedance-matching transformer, matching the output of the preamplifier to the cable that transmits the signal to the RI-FI Meter. The r-f signal and the local oscillator voltage are combined in the crystal mixer, resulting in a 160-mc signal. The resultant i-f signal is applied to the input of the i-f pre-amplifier.

NOTE

THE FOLLOWING DISCUSSION, THOUGH SPECIFICALLY DESCRIBING THE PREAMPLIFIER OF THE TN-128A/APR-9, (see Figure 2-11) IS APPLICABLE TO ALL FOUR R-F TUNERS, NOTING THE DIFFERENT COMPONENT SYMBOL NUMBERS AND MINOR CIRCUIT DIFFERENCES.

The three i-f amplifier stages V105, V106, and V107 are arranged in what is known as a stagger-tuned triple. The use of stagger tuning makes possible a wider bandwidth for a given gain than if all stages were tuned to an identical frequency. Inductances L105, L108, L113, and L121 are the tuning inductances of the stage networks, and each resonates with the total interstage capacitance present at a particular frequency. The frequencies, chosen on the basis of the theory of stagger tuning, are:

L113	High	172.0 mc
L121	Low	148.0 mc
L108	Center	160.0 mc
L105	Center	160.0 mc

The bandwidths of these individual stages are not all the same, the high and low stages having approximately half the bandwidth of the center. The center-stage bandwidth is the same as the desired overall bandwidth of the triple. The bandwidth of each stage is determined by the total damping across the tuned circuit. Damping results from the load resistors (R116, R118, and R122) in parallel with circuit losses, the output resistance of the tube feeding the circuit, the input resistance of the tube feeding the circuit, and the input resistance of the tube following the circuit. The input loading is the most important source of extraneous loading.

The screen and plate supply are common, the screen being fed directly from the supply bus (+105 volts) through a 10-ohm resistor. This resistor introduces practically no voltage drop; it is included to prevent parasitic oscillations, which would occur at about 500 mc if the resistor were not incorporated in the circuit. The supply voltage is fed to the plate through the load resistor and the plate is coupled to the grid of the following stage through a 50-mmf capacitor. Inductances L105, L108, L121, and L113 are the tunable elements of the interstage networks, and the capacitance of the resonant circuit is supplied by the inherent tube, socket, and wiring capacitances present. These coils are placed in the grid circuits rather than in the plate in order to maintain a low d-c resistance between grid and ground instead of a high resistance which would be the case if a resistor were used in the plate circuit. This procedure prevents blocking the amplifier upon sudden application of a signal. If a signal is sufficiently large to cause grid current to flow, blocking will occur if this current charges the coupling capacitor. Since this is a very low impedance to ground for dc and low frequencies, grid current drawn in this amplifier is "drained" directly to ground, so that no negative bias is built up on the coupling capacitor. The absence of blocking is so complete that two pulse signals of magnitudes differing by as much as 60 db may be present at the same time in the amplifier without interaction as long as the pulses are not exactly superimposed.

It will be noted that all supply busses (plate supply, filaments, cathode gain control, and the grid return bus for tubes V106 and V108) are fed from L-C decoupling networks. These networks act as low-pass filters which cut off well below the operating frequency of the amplifier, offering a very high degree of attenuation (approximately 40 db decoupling) between successive stages.

The gain of the preamplifier is controlled by varying the transconductance of the second and third

amplifiers. The transconductance is varied by inserting a resistance in series with the normal cathode bias source. This increases the negative bias, reducing the tube current and, therefore, the transconductance. It is desirable to control the gain close to the input of the amplifier in order to increase the overload capacity. However, varying the transconductance causes changes in the tube input loading; when stagger tuning is used, only certain stages can be controlled without excessive variations in the pass band resulting from different settings of the gain control. For this reason, tubes V105 and V108 are not connected to the control bus. The gain of the preamplifier is controlled by means of a gain control potentiometer on the R-F Tuner Power Supply PP-1179/URM-42.

A combination of a resistor and coil transform the impedance of the output circuit of the i-f preamplifier from the relatively high level at the plate of the final tube V108 to the low impedance of the coaxial line. Since the coil is resonated with the output capacitance of the final amplifier tube, the plate of the tube looks into a resistive load; because of the heavy loading effect of the resistor it is not necessary to tune the coil.

h. Reflector Voltage Network:

A voltage negative with respect to ground is provided for the reflex klystron in the local oscillator. The value of this voltage varies with each R-F Tuner. A reflector voltage network is connected in series with the cathode-to-resonator grid circuit of the klystron and the negative voltage is applied across this series circuit, the resonator grids being at ground potential. In all R-F Tuners, except the TN-130A/APR-9, this reflector voltage network consists of three voltage regulator tubes, connected in series, and a series resistance circuit shunted across the three tubes. The three voltage

Table 2-1, Comparison of R-F Tuners

POINT OF COMPARISON	R-F TUNER TN-128A/APR-9	R-F TUNER TN-129C/APR-9	R-F TUNER TN-130A/APR-9	R-F TUNER TN-131B/APR-9
Frequency Range (mc)	1000 - 2600	2300 - 4450	4300 - 7350	7050 - 10750
Local Oscillator Frequency (mc)	1160- 2760	2140 - 4290	4460 - 7510	6890 - 10590
Reflex Klystron	JAN-6BM6	JAN-6BL6	JAN-5721	USN-2K48
Reflector Mode	2-3/4	2-3/4	2-3/4	3-3/4
Oscillator Cavity Mode	$\frac{1}{4}$	$\frac{3}{4}$	$\frac{3}{4}$	$\frac{3}{4}$
Klystron Resonator Voltage (volts)	-280	-280	-1000	-1295
Klystron Cathode Current (ma)	20	20	18	12
Klystron Reflector-to-Cathode Voltage (volts)	-40 to -315	-45 to -290	-75 to -550	-75 to -240
Preselector Bandwidth (mc)	25 - 40	25 - 40	30 - 60	35 - 75
Preselector Cavity Cross-Section	Square	Square	Circular	Circular
Preselector Cavity Mode	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{3}{4}$	$\frac{3}{4}$
I-F Preamplifier Mid-Frequency (mc)	160	160	160	160
Crystal	JAN-1N21B	JAN-1N23B	JAN-1N23B	JAN-1N26

regulator tubes maintain a constant negative voltage across the network so that the cathode-to-resonator grid voltage of the klystron is held at a definite value. The resistance circuit of the reflector voltage network provides the reflector-to-cathode voltage, which varies continuously while the local oscillator is being tuned.

In the TN-130A/APR-9, the reflector voltage network comprises a series resistance circuit and a cathode follower circuit; these circuits function as a current and voltage regulator for the reflex klystron. For all reflex klystrons, the reflector voltage is obtained from a tap on a potentiometer which is part of the resistance circuit. In addition, two slot drive potentiometers provide adjustment of the reflector voltage at the low frequency and high frequency ends of the tuning range. These adjustments are necessary due to the variations in reflector voltage characteristics among reflex klystrons of a given type. Three test points are provided to check the voltages at the cathode and reflector electrodes of the klystron, and at the negative voltage input point.

i. Filament Voltage Circuit:

Filament voltage is supplied by two secondary windings of a filament transformer, one of which furnishes 6.3 volts to the klystron heater (and also to the cathode follower current regulator V306 in the TN-130A/APR-9), and the other 6.3 volts to the preamplifier tubes. High voltage is furnished through a receptacle from the R-F Tuner Power Supply PP-1179/URM-42.

j. Comparision of R-F Tuners:

A comparison of the main electrical and mechanical characteristics of the R-F Tuners is given in table 2-1. Detailed characteristics of each R-F Tuner are given in the immediately following sub-paragraphs.

k. R-F Tuner TN-128A/APR-9:

(1) General:

Sub-paragraphs 3k(2) through 3k(8) contain information which is applicable to R-F Tuner TN/-128A/APR-9 alone, and are a further development of sub-paragraphs 3a through 3j. Together these paragraphs present an overall discussion of the theory of operation of the TN-128A/APR-9. The unit covers the frequency range of 1000 to 2600 mc (1.00 to 2.60 kmc). The functional relationship of the major circuits is illustrated in Figure 2-2 and described in subparagraph 3b.

(2) R-F Preselector:

(See Figure 2-6). The preselector of R-F Tuner TN-128A/APR-9 consists of three coaxial cavities, square in cross section, with aperture-type coupling (refer to sub-paragraph 3c(3)) between cavities. To assure an i-f bandwidth of 20 mc, a preselector bandwidth of approximately 25 mc is provided at 1000 mc, and approximately 40 mc at 2600 mc. The cavities operate as one-quarter wavelength resonant lines which are tuned to the desired electrical length by movement of the center conductors. Noncontacting short-circuiting elements (refer to sub-paragraph 3c(2)) to the center conductors aid in eliminating troubles generally caused by sliding metallic contacts. Ball bearings support each conductor and keep them concentric within the noncontacting elements. The preselector is tuned by axial movement of the

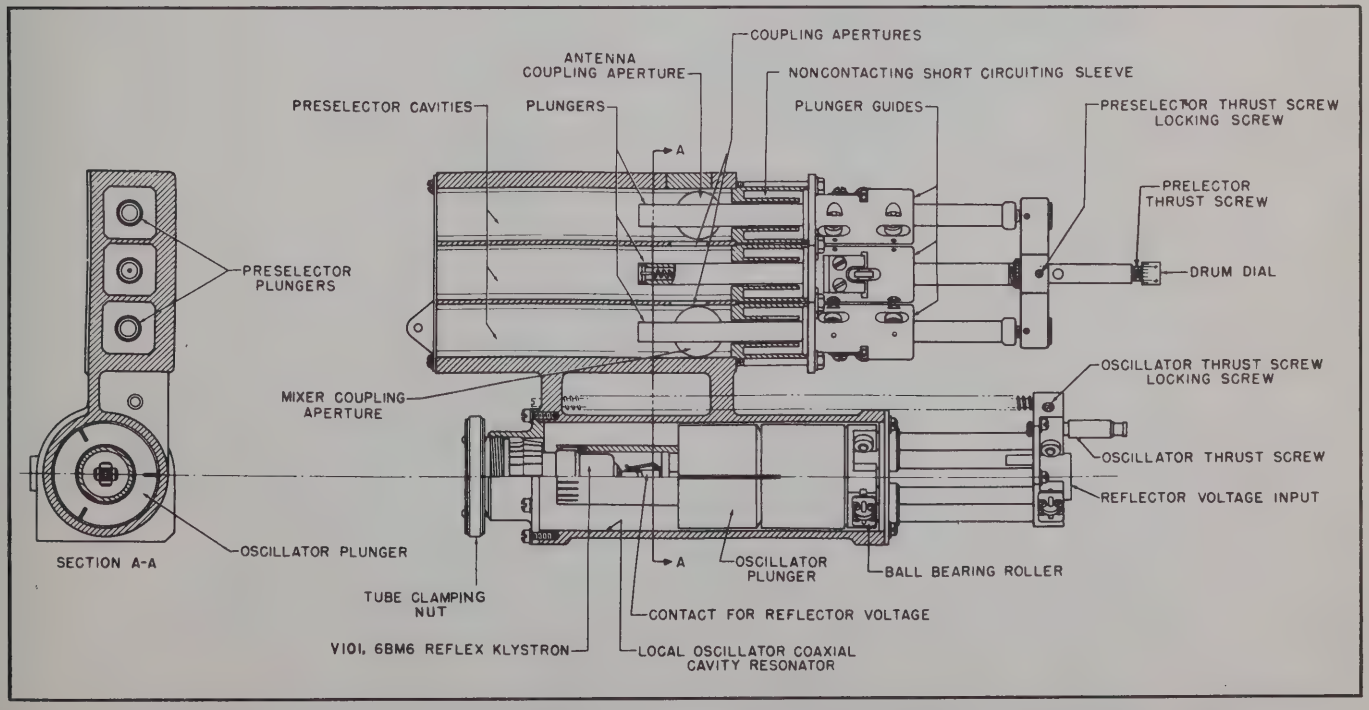

Figure 2-6, R-F Tuner TN-128A/APR-9, R-F Preselector and Local Oscillator, Cross Sectional View

center conductors, which, in effect, changes the length of the cavities. The center conductors (or plungers) are fastened by adjusting screws.

(3) Crystal Mixer:

(See Figure 2-7). The crystal mixer, a JAN-1N21B silicon crystal, converts the r-f signal from the preselector Z101 to a lower frequency, suitable for amplification, by combining the r-f signal with the local oscillator signal generated by V101, a 6BM6 reflex klystron. The i-f output voltage produced is fed to the i-f preamplifier Z106. CR101 is located behind a screw-on cap, which shields the crystal; it is secured in place by spring-finger contacts at the base and tip. The r-f signal from Z101 is coupled to CR101 through a circular terminating aperture, with a coupling loop, built into the base of the mixer. A short tapered section of coaxial line connects the aperture to the crystal. Power from Z103, the local oscillator, is supplied in parallel with the r-f signal through the cable assembly W101 and P105 into J105. A decoupling network, built into the mixer to present a high impedance at the point where power from Z103 is introduced, controls the amount of local oscillator power fed to the crystal and terminates the local oscillator-to-mixer coupling cable assembly W101. The network consists of an L-pad in which the series section is a 240-ohm, 1/2-watt resistor, R101, and the shunt section is a polyiron core inserted in the crystal holder assembly E118. The 160-mc i-f output signal from the crystal is fed to the grid of V105 through L105 in the 160-mc i-f preamplifier Z106.

(4) Local Oscillator: (See Figure 2-7.)

(a) General:

The local oscillator of R-F Tuner TN-128A/APR-9 uses a JAN-6BM6 reflex klystron, V101, and a coaxial cavity resonator external to the tube. The oscillator tunes over a frequency range from 1160 to 2760 mc, that is, always 160-mc above the r-f signal frequency. The cavity resonator is tuned by means of a noncontacting short-circuiting plunger (see Figures 2-5 and 2-6) and the reflector-to-cathode voltage is varied and tracks with the movement of the plunger through the mechanical drive system. Power is extracted from the resonator by probe coupling, at a fixed point in the cavity. Oscillator power is delivered to the mixer where it is attenuated before it is applied to the crystal.

(b) Reflex Klystron:

Figure 2-8 shows the reflector transit mode

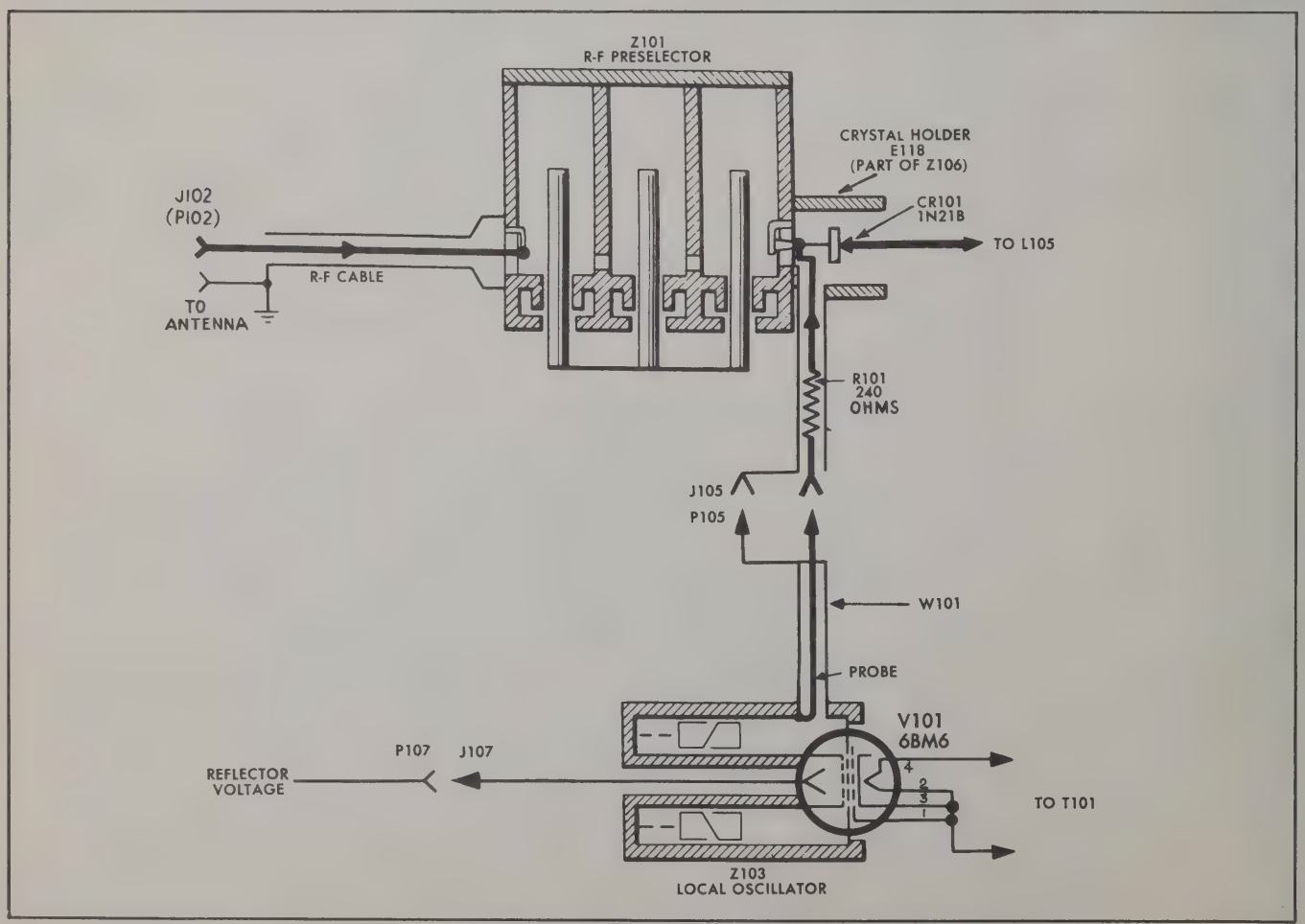

Figure 2-7, R-F Tuner TN-128A/APR-9, Input Circuit, Schematic Diagram

characteristic of the JAN-6BM6 reflex klystron. The local oscillator operates throughout the frequency range on the 2-3/4-cycle reflector transit mode with the reflector-to-cathode voltage varying from approximately -40 to -315 volts. The tube operates with a resonator grid-to-cathode potential of 280 volts and an average cathode current of 20 ma. V101 contains a control grid between the cathode and resonator grids. (See Figure 2-7.) For normal operation, this grid is connected to the cathode. The external connection to the reflector of V101 is a cap at the top of the tube, with a four-pin base providing heater, cathode, and control grid connections. The external connections to the two resonator grids are concentric rings.

(c) Coaxial Cavity Resonator:

The theory of operation of coaxial cavity resonators is discussed in sub-paragraph 3e(2). Construction of the TN-128A/APR-9 coaxial cavity resonator is shown in Figure 2-6. The outer conductor of the coaxial cavity is machined from a common preselector-oscillator body of cast aluminum. The silver-plated brass center-conductor assembly is extended beyond the end of the outer conductor body and is supported by means of a flange. At the tube end of the center conductor are flexible fingers to grasp the second resonator grid ring of the tube, giving multipoint electrical contact around its periphery. A stopping shoulder is provided in the end of the center conductor to insure proper positioning of the tube as it is inserted from the end of the resonator. The reflector voltage lead is brought into the rear end of the center conductor and is connected to a terminal assembly inside the conductor near the tube end. This assembly consists of a four-finger spring clip, which grips the reflector electrode terminal of the tube. A tube clamp and end plate assembly is mounted on the tube end of the outer conductor body of the cavity. Included in this assembly is another finger ring which contacts the grid ring of the first resonator. The finger ring is provided with collet-type action. The grasp of the fingers is automatically correct when the nut on the collet tube is tightened. Construction of the noncontacting tuning plunger is similar to that shown in Figure 2-5, except that no lossy polyiron slugs are used and there is no slotting in the inner coaxial gap. It is maintained in an axial position in the cavity by a set of three ball bearing wheels, mounted on its rear face, which roll on the rear of the center conductor, and is connected by three rods with a similar carriage riding on the extension of the center conductor at the rear of the cavity. Figure 2-6 shows the plunger and its supports. In each group of three ball bearings, two are fixed in position and one is

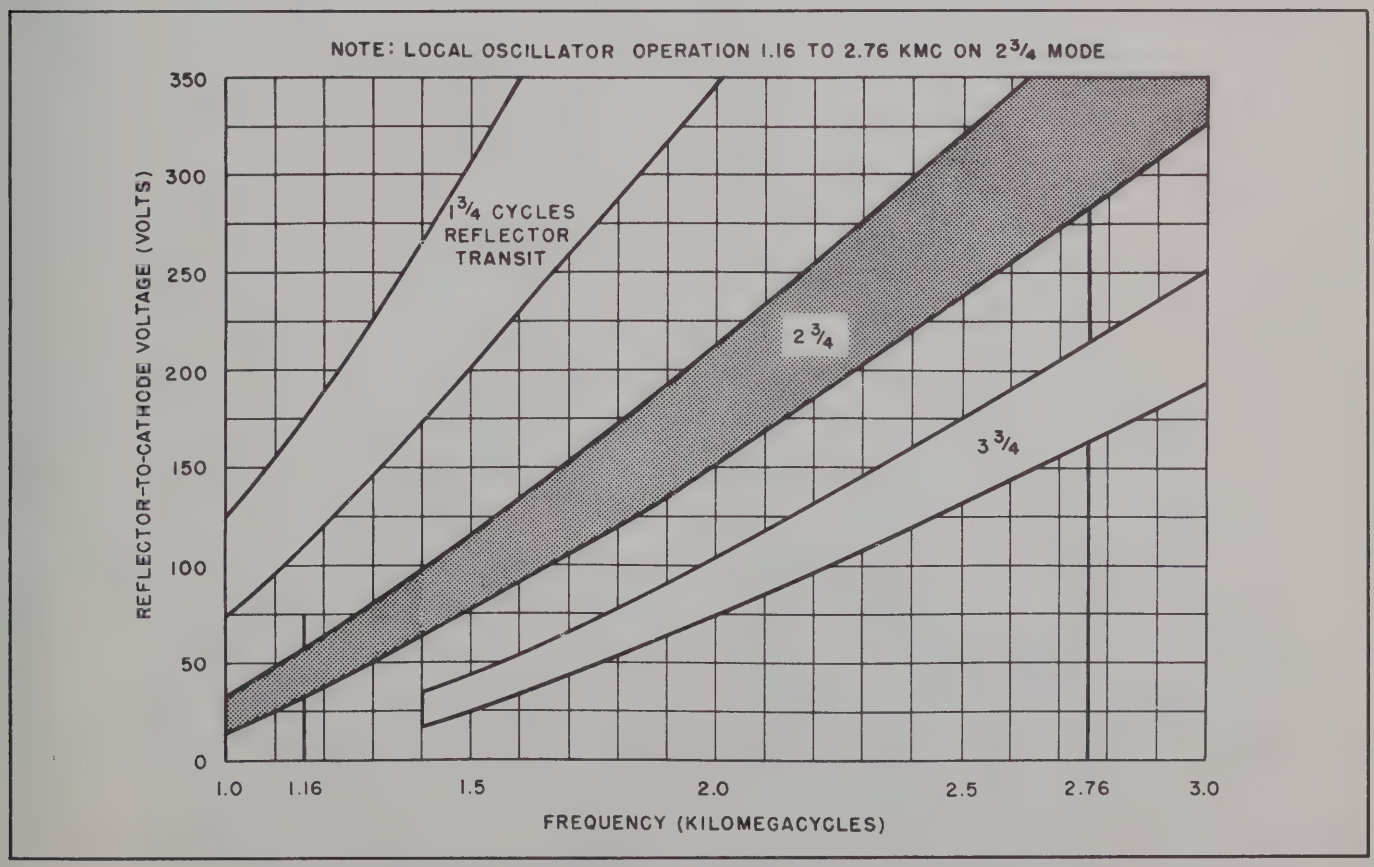

Figure 2-8, Reflector Transit Mode Characteristic of JAN-6BM6 Reflex Klystron

spring-loaded against the central tube.

(d) Oscillator Output Coupling:

Power is extracted from the cavity resonator by probe coupling at a fixed point in the cavity. Further details of the coupling system will be found in sub-paragraph 3e(3).

(5) Mechanical Tuning System:

(a) General:

The mechanical tuning system of R-F Tuner TN-128A/APR-9 consists of suitable gears and cams ganging the tuning of the r-f preselector Z101, counter dial N101, local oscillator Z103, reflector voltage potentiometer R104, sector sweep potentiometer R105, synchro generator G101, and tuning motor B101.

NOTE

TUNING MOTOR B101 IS DISENGAGED AT ALL TIMES DUE TO PLACEMENT OF A TUNING KNOB ON THE LOCAL TUNING CONTROL. SECTOR SWEEP POTENTIOMETER R105 AND SYNCHRO GENERATOR G101 ARE WITHOUT FUNCTIONS IN THE AN/URM-42 APPLICATION OF THE R-F TUNER.

Figure 2-9 is an overall schematic diagram of the TN-128A/APR-9 R-F Tuner and illustrates the detailed elements of this system. Figure 2-10 is a schematic diagram of the gear system used to drive the tunable elements of the system, and shows the cam system used to convert the linear wavelength tuning of the local oscillator and preselector to a rotary linear frequency variation.

(b) Mechanical Linkage:

The mechanical linkage and gearing is shown in Figure 2-10. Drive motor B101 is disengaged by a clutch mechanism which is actuated by a pin extending from the tip of the local tuning control shaft. This pin is actuated at all times by the knob on the front panel end of the shaft. The main drive shaft is driven by the front panel knob. The front end of the drive shaft is geared to the synchro generator G101 and the counter N101. The rear end of the shaft is geared to potentiometers R104 and R105 through a gear which also operates the limit switches S101 and S102. These switches are without functions in that the motor is disengaged from the drive shaft and does not have power applied to its windings. A worm thread on the main drive shaft turns a worm gear which actuates the oscillator and preselector cams.

(c) Oscillator and Preselector Cams:

The preselector cam and the oscillator cam are mounted on a common shaft, with the oscillator cam mounted directly behind the preselector cam. As the cams rotate, due to the gear motion initiated by the front panel tuning control, the local oscillator tuning plunger and the preselector tuning carriage are actuated through pivoting lever arms. Each lever arm contains two rollers, one riding on the face of the cam, the other driving the tuning mechanism. Since the rotation of the cams' drive shaft is linearly proportional to frequency, the cams are shaped to transform the approximately linear wavelength-versus-cavity-length tuning of the oscillator and preselector to a linear frequency tuning, while tracking them with each other and with the frequency indicating counter N101.

(d) Oscillator Tracking Adjustments:

The contour of the oscillator cam face may be adjusted by small amounts in order to accomodate all JAN-6BM6 reflex klystrons which require, within manufacturing tolerances, some variation in plunger position for a fixed oscillation frequency. For this purpose two independent adjustments are provided, one at each extreme end of the frequency range. These screwdriver adjustments, available through cutouts in the preselector cam, control eccentrics which vary either the upper-frequency or lower-frequency half of the cam face length, depending on which adjustment is made. An engraved dot on each eccentric indicates the direction of maximum throw of the eccentric. A third independent adjustment is provided by a threaded thrust screw adjustment (see Figure 2-6) which varies the effective length of the oscillator plunger thrust screw. This adjustment is made at the center frequency of the tuning range. Each of the three adjustments is provided with independent locking screws. The temperature compensator is mounted on the oscillator thrust screw. The change in length of the compensator with temperature changes causes the expansion or contraction of the thermal elements, which, in turn, causes the oscillator frequency to remain in proper relationship to the preselector tuning frequency.

(e) Preselector Tracking Adjustments:

The contour of the preselector cam face consists of a flexible strip of metal stretched tightly over a series of 15 eccentric studs spaced equally along a suitable cam on the cam plate. (See Figure 2-10.) Each stud may be rotated by inserting the special wrench, provided with each TN-128A/APR-9, into the slots of the studs. When a stud is rotated, the cam radius at that point is varied as a result of the stud eccentricity. Hence, multipoint independent adjustment of the cam shape is available, providing accurate tracking of the preselector with the oscillator over the entire frequency range. All preselector cam adjustments have individual central locking screws. In addition, a preselector thrust screw adjustment is provided to aid in aligning and testing the preselector. This adjustment has a locking set screw. (See Figure 2-6). Further tracking adjustments are provided by sidetracking adjustment screws which are mounted in the cavity block

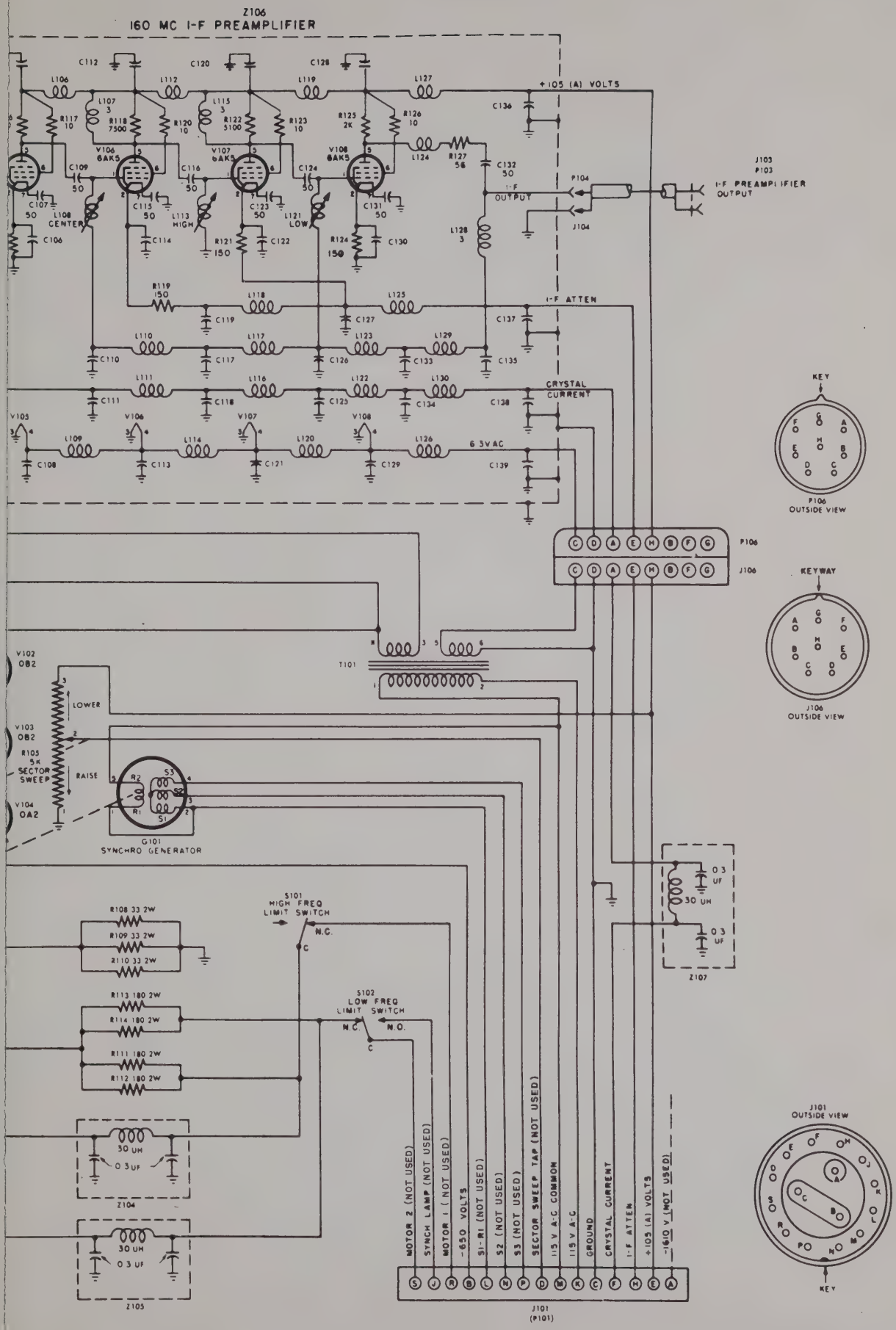

Figure 2-9, R-F Tuner TN-128A/APR-9, Schematic Diagram

spring-loaded against the central tube.

(d) Oscillator Output Coupling:

Power is extracted from the cavity resonator by probe coupling at a fixed point in the cavity. Further details of the coupling system will be found in sub-paragraph 3e(3).

(5) Mechanical Tuning System:

(a) General:

The mechanical tuning system of R-F Tuner TN-128A/APR-9 consists of suitable gears and cams ganging the tuning of the r-f preselector Z101, counter dial N101, local oscillator Z103, reflector voltage potentiometer R104, sector sweep potentiometer R105, synchro generator G101, and tuning motor B101.

NOTE

TUNING MOTOR B101 IS DISENGAGED AT ALL TIMES DUE TO PLACEMENT OF A TUNING KNOB ON THE LOCAL TUNING CONTROL. SECTOR SWEEP POTENTIOMETER R105 AND SYNCHRO GENERATOR G101 ARE WITHOUT FUNCTIONS IN THE AN/URM-42 APPLICATION OF THE R-F TUNER.

Figure 2-9 is an overall schematic diagram of the TN-128A/APR-9 R-F Tuner and illustrates the detailed elements of this system. Figure 2-10 is a schematic diagram of the gear system used to drive the tunable elements of the system, and shows the cam system used to convert the linear wavelength tuning of the local oscillator and preselector to a rotary linear frequency variation.

(b) Mechanical Linkage:

The mechanical linkage and gearing is shown in Figure 2-10. Drive motor B101 is disengaged by a clutch mechanism which is actuated by a pin extending from the tip of the local tuning control shaft. This pin is actuated at all times by the knob on the front panel end of the shaft. The main drive shaft is driven by the front panel knob. The front end of the drive shaft is geared to the synchro generator G101 and the counter N101. The rear end of the shaft is geared to potentiometers R104 and R105 through a gear which also operates the limit switches S101 and S102. These switches are without functions in that the motor is disengaged from the drive shaft and does not have power applied to its windings. A worm thread on the main drive shaft turns a worm gear which actuates the oscillator and preselector cams.

(c) Oscillator and Preselector Cams:

The preselector cam and the oscillator cam are mounted on a common shaft, with the oscillator cam mounted directly behind the preselector cam. As the cams rotate, due to the gear motion initiated by the front panel tuning control, the local oscillator tuning plunger and the preselector tuning carriage are actuated through pivoting lever arms. Each lever arm contains two rollers, one riding on the face of the cam, the other driving the tuning mechanism. Since the rotation of the cams' drive shaft is linearly proportional to frequency, the cams are shaped to transform the approximately linear wavelength-versus-cavity-length tuning of the oscillator and preselector to a linear frequency tuning, while tracking them with each other and with the frequency indicating counter N101.

(d) Oscillator Tracking Adjustments:

The contour of the oscillator cam face may be adjusted by small amounts in order to accomodate all JAN-6BM6 reflex klystrons which require, within manufacturing tolerances, some variation in plunger position for a fixed oscillation frequency. For this purpose two independent adjustments are provided, one at each extreme end of the frequency range. These screwdriver adjustments, available through cutouts in the preselector cam, control eccentrics which vary either the upper-frequency or lower-frequency half of the cam face length, depending on which adjustment is made. An engraved dot on each eccentric indicates the direction of maximum throw of the eccentric. A third independent adjustment is provided by a threaded thrust screw adjustment (see Figure 2-6) which varies the effective length of the oscillator plunger thrust screw. This adjustment is made at the center frequency of the tuning range. Each of the three adjustments is provided with independent locking screws. The temperature compensator is mounted on the oscillator thrust screw. The change in length of the compensator with temperature changes causes the expansion or contraction of the thermal elements, which, in turn, causes the oscillator frequency to remain in proper relationship to the preselector tuning frequency.

(e) Preselector Tracking Adjustments:

The contour of the preselector cam face consists of a flexible strip of metal stretched tightly over a series of 15 eccentric studs spaced equally along a suitable cam on the cam plate. (See Figure 2-10.) Each stud may be rotated by inserting the special wrench, provided with each TN-128A/APR-9, into the slots of the studs. When a stud is rotated, the cam radius at that point is varied as a result of the stud eccentricity. Hence, multipoint independent adjustment of the cam shape is available, providing accurate tracking of the preselector with the oscillator over the entire frequency range. All preselector cam adjustments have individual central locking screws. In addition, a preselector thrust screw adjustment is provided to aid in aligning and testing the preselector. This adjustment has a locking set screw. (See Figure 2-6). Further tracking adjustments are provided by sidetracking adjustment screws which are mounted in the cavity block

NOTES:

1. All resistor values are in ohms unless followed by "K" - kilohm (1,000 ohms). Tolerance is ±5% and power rating is ½ watt unless otherwise indicated.
2. All capacitor values are in micromicrofarads - "UUF", unless followed by "UF" - microfarad, and are 1,000 UUF unless otherwise indicated.
3. All fixed inductor values are in microhenries - "UH" and are approximately 0.25 UH unless otherwise indicated.
4. Limit switches S101 and S102 are normally closed as shown.
5. Crystal holder is part of I-F Preamplifier Z106.

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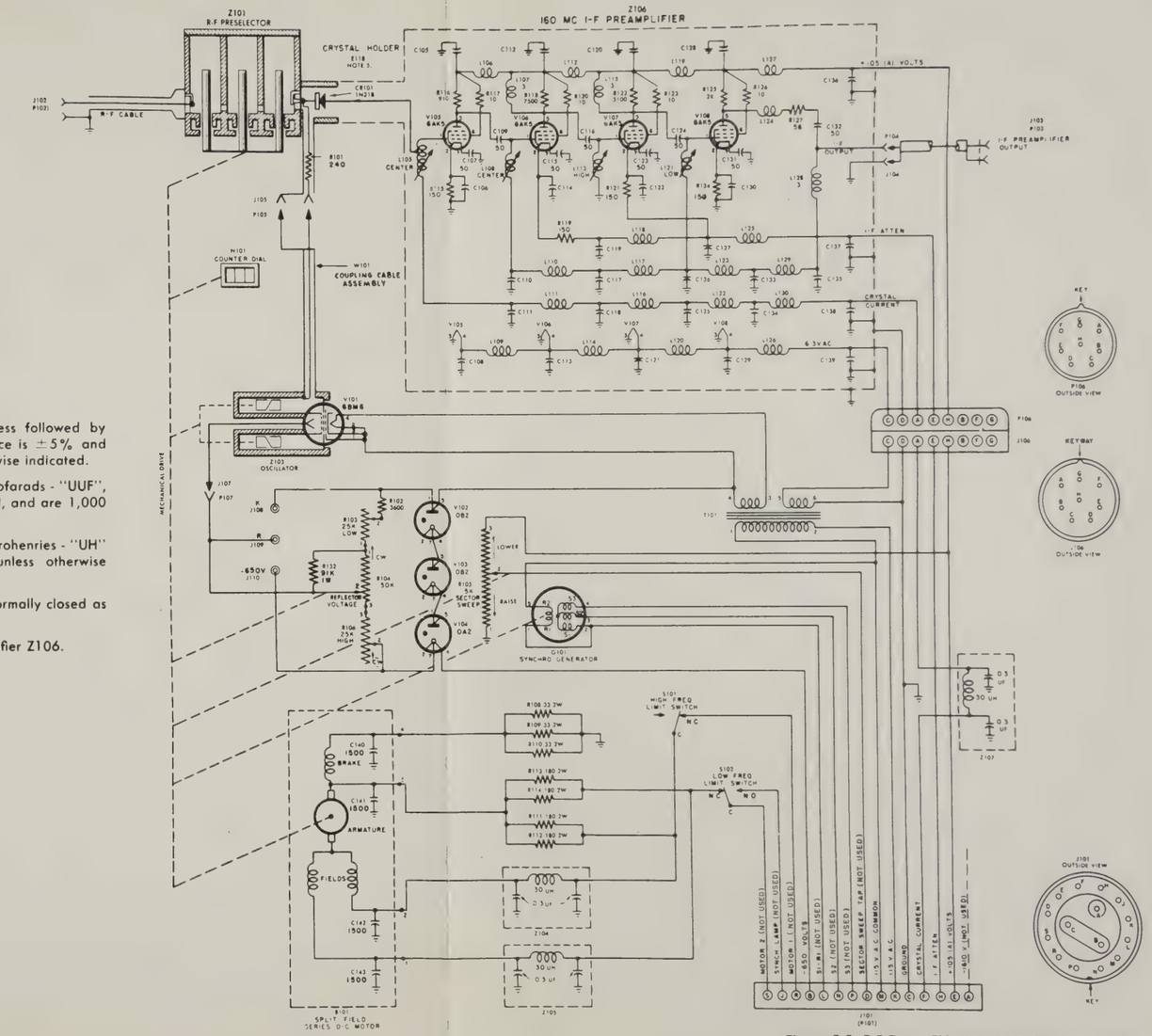

Figure 2-9, R-F Tuner TN-128A/APR-9, Schematic Diagram

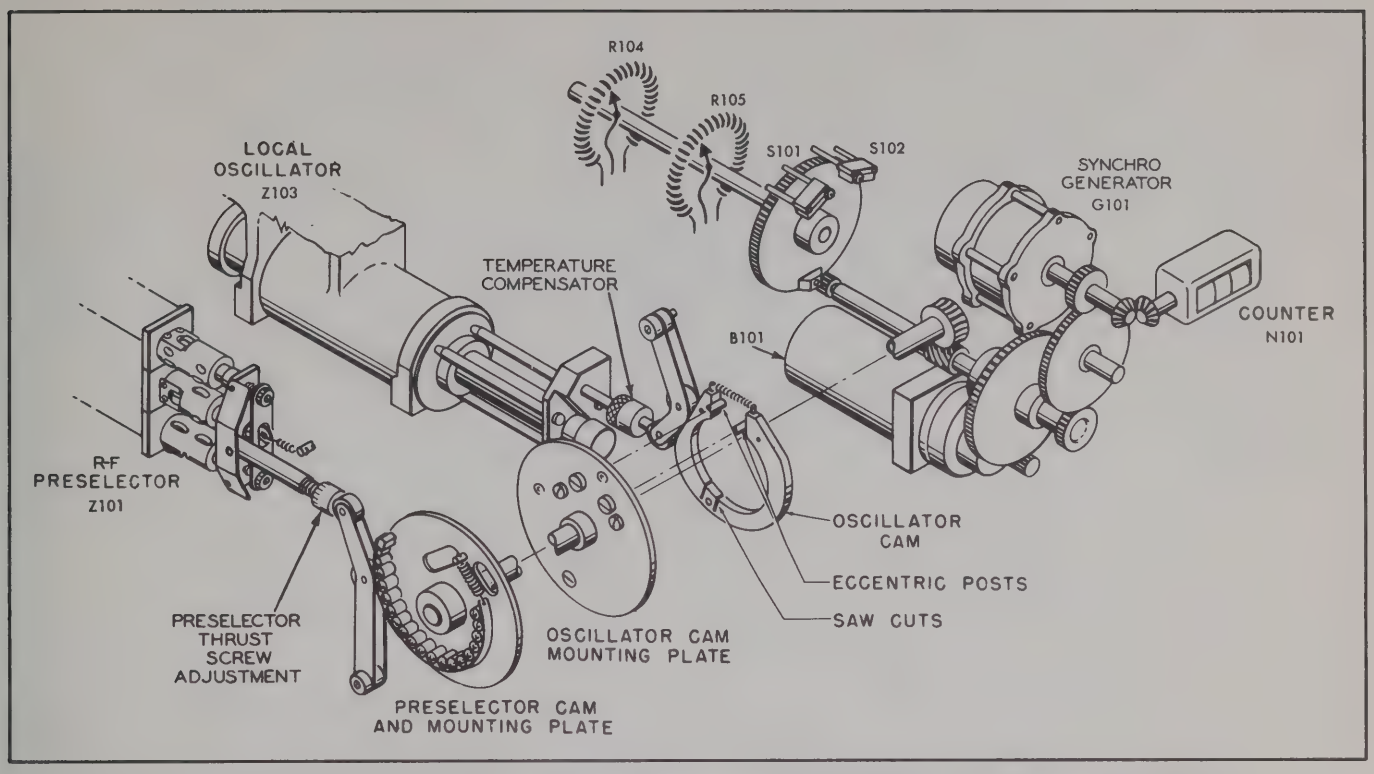

Figure 2-10, R-F Tuner TN-128A/APR-9, Mechanical Tuning Linkage, Schematic Diagram

perpendicular to the axes of the cavities. The two side cavities each contain six screws, while the center cavity contains one. During factory alignment of the preselectors, these screws are adjusted so as to protrude into the cavity or recede from it, thereby compensating for distortions in the tuning characteristic introduced into the input and output cavities by the coupling devices and by variations in mechanical tolerances.

CAUTION

THESE TRACKING SCREWS ARE COVERED BY A PROTECTIVE PLATE MARKED FACTORY ADJUSTMENT - DO NOT DISTURB. THEY MUST NOT BE TAMPERED WITH BY OPERATING, OR UNQUALIFIED MAINTENANCE, PERSONNEL.

(6) I-F Preamplifier:

The theory of operation of the TN-128A/APR-9 i-f preamplifier is described in sub-paragraph 3g of this section.

(7) Reflector Voltage Network:

(See Figure 2-9.) A voltage of -650 volts with respect to ground is furnished for the reflex klystron V101. The reflector voltage network of the TN-128A/APR-9 consists of three series-connected voltage regulator tubes V102, V103, and V104, and the series-connected resistive circuit consisting of R102, R103, R104, and R106, together with R132 which is connected from one side of R104 to the movable arm. The complete resistive circuit is shunted across the voltage regulator tube circuit. R132 converts the linear potentiometer R104 into a nonlinear potentiometer, since the JAN-6BM6 reflex klystron V101 operates most efficiently when the relationship between the applied reflector voltage and the frequency is slightly nonlinear. (See Figure 2-8.) The moving arm of R104, connected through P107 and J107 to the reflector of V101 and tracked by the mechanical drive system, furnishes the correct voltage. R103 permits adjustment of the voltage at the low-frequency end of the tuning range and R106 permits adjustment at the high-frequency end. Three test points, J108, J109, and J110, are provided to check the voltages at the cathode and reflector electrodes of V101 and at the -650-volt input.

(8) Filament Voltage Circuit:

Filament voltage is furnished by transformer T101 from two secondary windings, one of which supplies 6.3 volts to the heater of V101, the other, 6.3 volts to V105, V106, V107, and V108. Plate voltage for the i-f preamplifier is furnished through J101 from the R-F Tuner Power Supply. (See Figure 2-7 and 2-9.)

l. R-F Tuner TN-129C/APR-9:

(1) General:

Sub-paragraphs 31(2) through 31(8) contain information which is applicable to R-F Tuner TN-129C/APR-9 alone, and are a further development of sub-paragraphs 3a through 3j. Together these paragraphs present an overall discussion

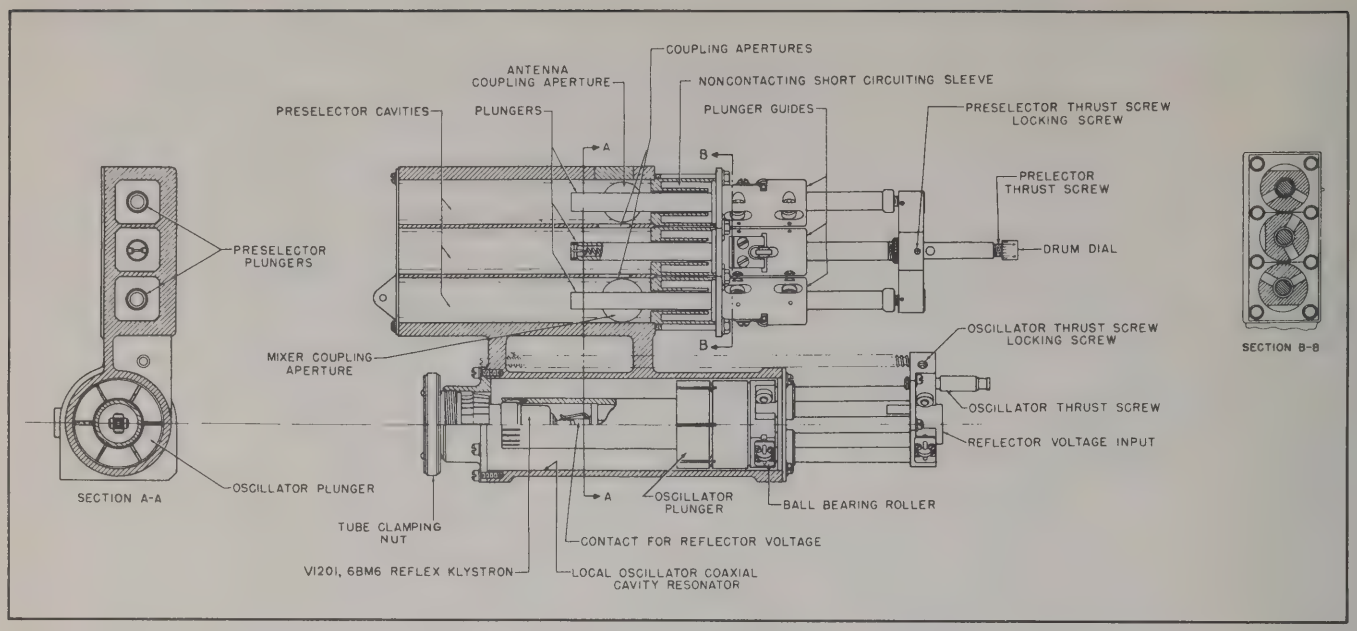

Figure 2-11, R-F Tuner TN-129C/APR-9, R-F Preselector and Local Oscillator, Cross Sectional View

of the theory of operation of the unit. TN-129C/APR-9 covers the frequency range of 2300 to 4450 mc (2.30 to 4.45 kmc). The functional relationship of the major circuits is illustrated in Figure 2-2 and described in sub-paragraph 3b.

(2) R-F Preselector:

(See Figure 2-11.) The preselector of R-F Tuner TN-129C/APR-9 contains three coaxial cavities, square in cross section, with aperture-type coupling (refer to sub-paragraph 3c(3)) between cavities. To allow for backlash and other tracking errors between the local oscillator and the preselector, a preselector bandwidth of approximately 25 mc is provided at 2300 mc, and approximately 40 mc at 4450 mc. The cavities operate as one-quarter wavelength resonant lines tuned to the desired electrical length by axial movement of the center conductors. To eliminate the problems associated with sliding metallic contacts (tuning noise, erratic contacts, friction, and wear), a noncontacting short circuit to the center conductor is provided at the end of each cavity. (Refer to sub-paragraph 3c(2)). Separate ball bearing guides are used to support each center conductor and to keep it concentric within the noncontacting element. The center conductors, or plungers, are ganged together by a yoke to which the inner plunger is fastened directly, and the two outer plungers are fastened through adjusting screws and thrust bearings. The thrust bearings allow for any slight misalignment of the three ball bearing guides, the adjusting screws provide means for initial alignment of the plunger lengths. The ganged plungers are driven by a preselector cam through a preselector lever arm which acts on the preselector thrust screw. A bimetallic temperature compensator is mounted on the oscillator thrust screw and functions in a manner similar to that of the TN-128A/URM-42. Mechanically, the TN-129C is very similar to the TN-128A/APR-9.

(3) Crystal Mixer:

(See Figure 2-12). The r-f signal from Z201 is combined with the r-f signal generated by CR201, a type JAN-1N23B silicon crystal. The i-f output is fed to the i-f preamplifier. Power from Z203, the local oscillator, is paralleled with the crystal signal through P205 into J205. The decoupling network, built into the mixer to present a high impedance at the point where power from Z203 is introduced, controls the amount of local oscillator power fed to the crystal and terminates the local oscillator-to-mixer coupling cable. The network consists of an L pad in which the shunt

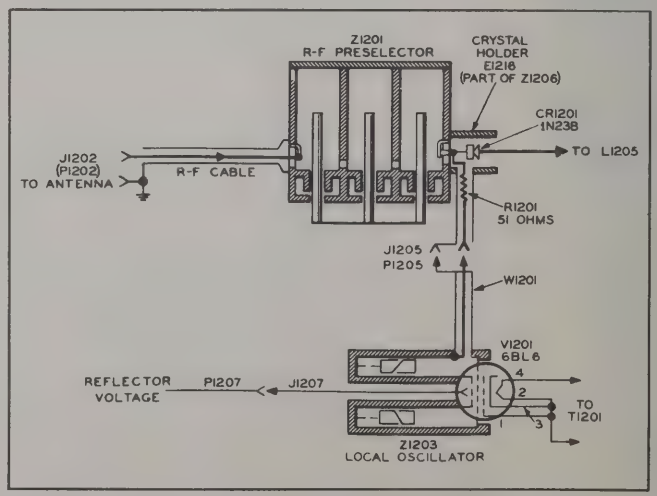

Figure 2-12, R-F Tuner TN-129C/APR-9, Input Circuit, Schematic Diagram

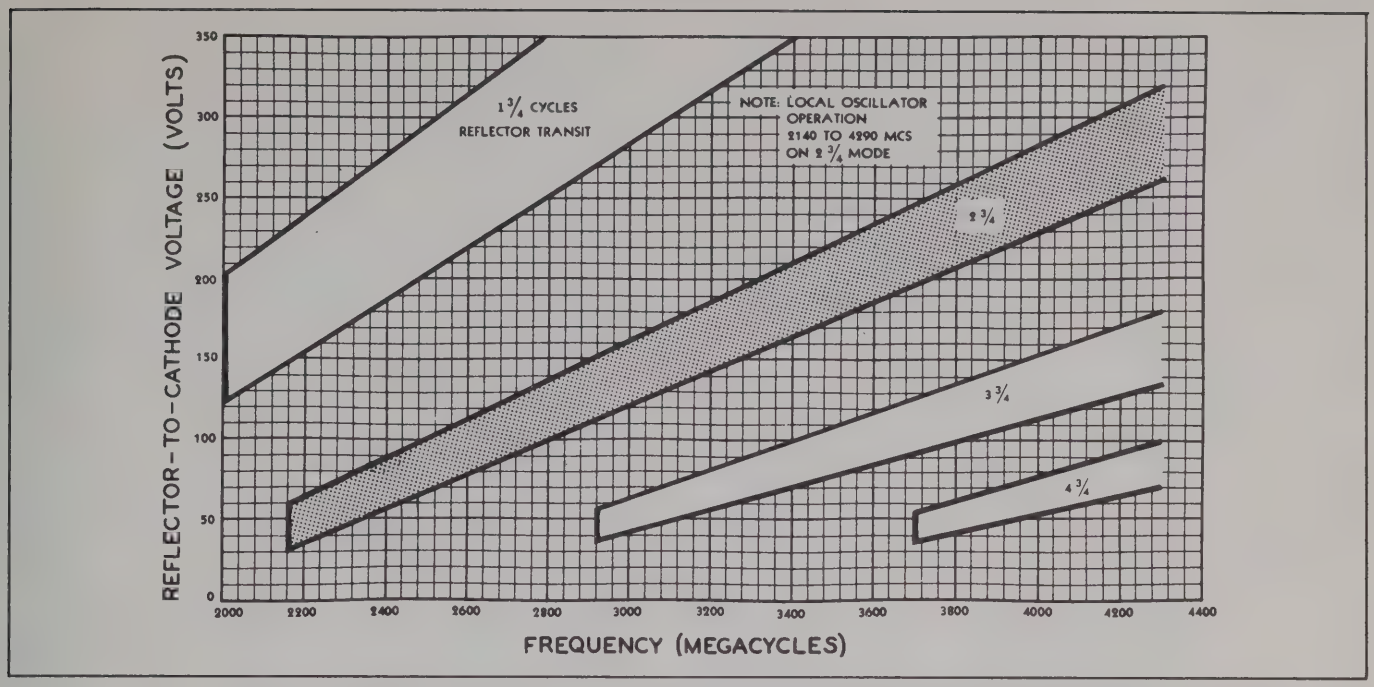

Figure 2-13, Reflector Transit Mode Characteristics of JAN-6BL6 Reflex Klystron

element is a polyiron core inserted in the crystal holder assembly and a 51-ohm resistor, R1201, is included as the series section.

The 51-ohm resistor R201 acts as a lossy dielectric in which the loss increases with frequency because of the effect of the shunting capacitance along its length. Thus, the resistor is the main factor that controls the amount of local oscillator power fed to the crystal at the high-frequency end of the range, and the polyiron core in the r-f output terminal of Z203 is the main factor at the low end. The change in resistance of the elements also tends to decrease the isolation between the local oscillator and the crystal as the frequency increases. This causes the sensitivity of the receiver to be poorer at the high-frequency end of the range than at the low end. The 160-mc i-f output signal from the crystal is fed directly to the grid of the first preamplifier stage through as short a lead as possible.

(4) Local Oscillator: (See Figure 2-12).

(a) General:

The local oscillator uses a JAN-6BL6 reflex klystron tube (V201) and a coaxial cavity resonator external to the tube. The oscillator tunes over the range from 2140 to 4290 mc, always at 160 mc below the r-f signal frequency. The resonator is tuned by means of a noncontacting short-circuiting plunger; the reflector-to-cathode voltage of the tube is simultaneously varied, and it tracks with the movement of the plunger through a mechanical drive system. Power is extracted from the resonator by loop coupling at a fixed point in the cavity. The power available from the oscillator is delivered to the mixer, where it is attenuated before it is applied to the crystal.

(b) Reflex Klystron:

The local oscillator tube V201 is a reflex klystron which requires an external cavity resonator. Figure 2-13 shows the reflector transit mode characteristics of the JAN-6BL6 klystron. The local oscillator operates throughout the range on the 2-3/4 reflector transit cycles, 3/4 cavity wavelength mode, thus, the reflector-to-cathode voltage varies from about -45 to -290 volts. The tube operates with a resonator grid-to-cathode potential of 280 volts, and an average cathode current of approximately 20 ma. The JAN-6BL6 contains a control grid located between cathode and resonator grids, and for normal cw operation this grid is connected to the cathode. The external connection to the reflector of V201 is a cap at the top of the tube, while a four-prong base provides connections for heater, cathode, and control grid. The external connections to the two resonator grids are concentric rings.

(c) Coaxial Cavity Resonator:

The theory of operation of coaxial cavity resonators is discussed in sub-paragraph 3e(2). A cross-sectional view of the resonator is shown in Figure 2-11. Due to the higher frequency range covered, the resonator of the TN-129C/APR-9 uses plungers having different lengths than those of the TN-128A/APR-9. In addition, polyiron slugs are inserted in the axial slots of the special plungers. (See Figure 2-5). Except for these differences, the resonator is very similar to that utilized in the TN-128A/APR-9. It is the purpose of the lossy dielectric (polyiron) to eliminate interfering parasitic resonances. These

may be set up, causing erratic operation of the oscillator within the tuning range, since higher order resonances having circumferential current flow can be excited within the plunger.

(d) Oscillator Output Coupling:

The coupling system used to extract power from the local oscillator consists of a small probe, fixed in position and located just inside the outer conductor near the tube end of the cavity. Further details of the coupling system can be found in sub-paragraph 3e(3).

(5) Mechanical Tuning System: (See Figure 2-14)

(a) General:

The mechanical tuning system gangs the tuning of the r-f preselector Z201, the counter dial N1201, the local oscillator Z203, the reflector voltage potentiometer R204, the sector sweep potentiometer R205, the synchro generator G1201, and the drive motor B201.

NOTE

TUNING MOTOR B201 IS DISENGAGED AT ALL TIMES DUE TO PLACEMENT OF A TUNING KNOB ON THE LOCAL TUNING CONTROL. SECTOR SWEEP POTENTIOMETER R205 AND SYNCHRO GENERATOR G201 ARE WITHOUT FUNCTIONS IN THE AN/URM-42 APPLICATION OF THE R-F TUNER.

Figure 2-14 is a complete schematic diagram of the TN-129C/APR-9 Tuner and shows the detailed parts of the system in schematic form. Figure 2-15 illustrates the mechanical linkage and the gear system used to drive the components.

(b) Mechanical Linkage:

The mechanical linkage and gearing is shown schematically in Figure 2-15. Except for the use of 18 eccentric studs on the preselector cam and physical differences because of the different frequency range covered, the operation of the mechanical linkage system is similar to that of the TN-128A/APR-9 (refer to subparagraph 3k(5) (b).

(6) I-F Preamplifier:

The theory of operation of the TN-129C/APR-9 i-f preamplifier is described in sub-paragraph 3g of this section.

(7) Reflector Voltage Network:

(See Figure 2-14). A voltage of -650 volts with respect to ground is provided for the reflex klystron. The reflector voltage network consists of three series-connected voltage regulator tubes V202, V203, and V204, together with resistors R203, R204, R206, and R207, also connected in series. The resistor circuit is shunted across the voltage regulator tube circuit. The resistive circuit provides the reflector-to-cathode voltage. The voltage regulator tubes maintain the voltage across the network constant so that the voltage between the cathode and the grounded resonator grids of the klystron is held at -280 volts. The moving arm of R204, connected through P207 and J207 to the reflector electrode of the klystron and tracked by the mechanical drive system, provides the correct voltage. R203 provides adjustment of the reflector voltage at the low-frequency end of the tuning range, while R206 provides adjustment at the high frequency end. Three test points J208, J209, and J210 are provided to check the voltages at the cathode and reflector electrodes of V201 and at the -650-volt input.

(8) Filament Voltage Circuit:

Filament voltage is furnished by transformer T201 from two secondary windings, one of which furnishes 6.3 volts to the heater of V201, the other 6.3 volts to V205, V206, V207, and V208. Plate voltage for the i-f preamplifier is furnished through J206 from the R-F Tuner Power Supply PP-1179/URM-42.

m. R-F Tuner TN-130A/APR-9:

(1) General:

Sub-paragraphs 3m(2) through 3m(8) contain information which is applicable to R-F Tuner TN-130A/URM-42 alone, and are a further development of sub-paragraphs 3a through 3j. Together these paragraphs present an overall discussion of the theory of operation of the TN-130A/APR-9. The unit covers the frequency range of 4300 to 7350 mc (4.30 to 7.35 kmc). The functional relationship of the major circuits is illustrated in Figure 2-2 and described in sub-paragraph 3b.

(2) R-F Preselector:

(See Figure 2-16). The preselector of R-F Tuner TN-130A/APR-9 consists of three overcoupled coaxial cavities, circular in cross section, with aperture-type coupling (refer to sub-paragraph 3c(3)) between cavities. To assure an i-f bandwidth of 20 mc, a preselector bandwidth of approximately 30 mc is provided at 4300 mc and approximately 60 mc at 7350 mc. The cavities operate as three-quarter wavelength resonant lines, open-circuited at one end and short-circuited at the other end. Noncontacting short-circuiting elements are used to eliminate tuning noise. (Refer to sub-paragraph 3c(2)). The plungers are tuned to the desired electrical length by axial movement of the center conductors which in effect changes the length of the cavities. The outer conductors of the cavities are formed by three holes bored through an aluminum block, which is fastened rigidly to the frame of the preselector. (See Figure 2-16). The plungers are mounted in a common supporting carriage which supports and maintains each plunger concentric within the noncontacting short-circuiting elements placed at the end of each cavity. Each conductor is independently

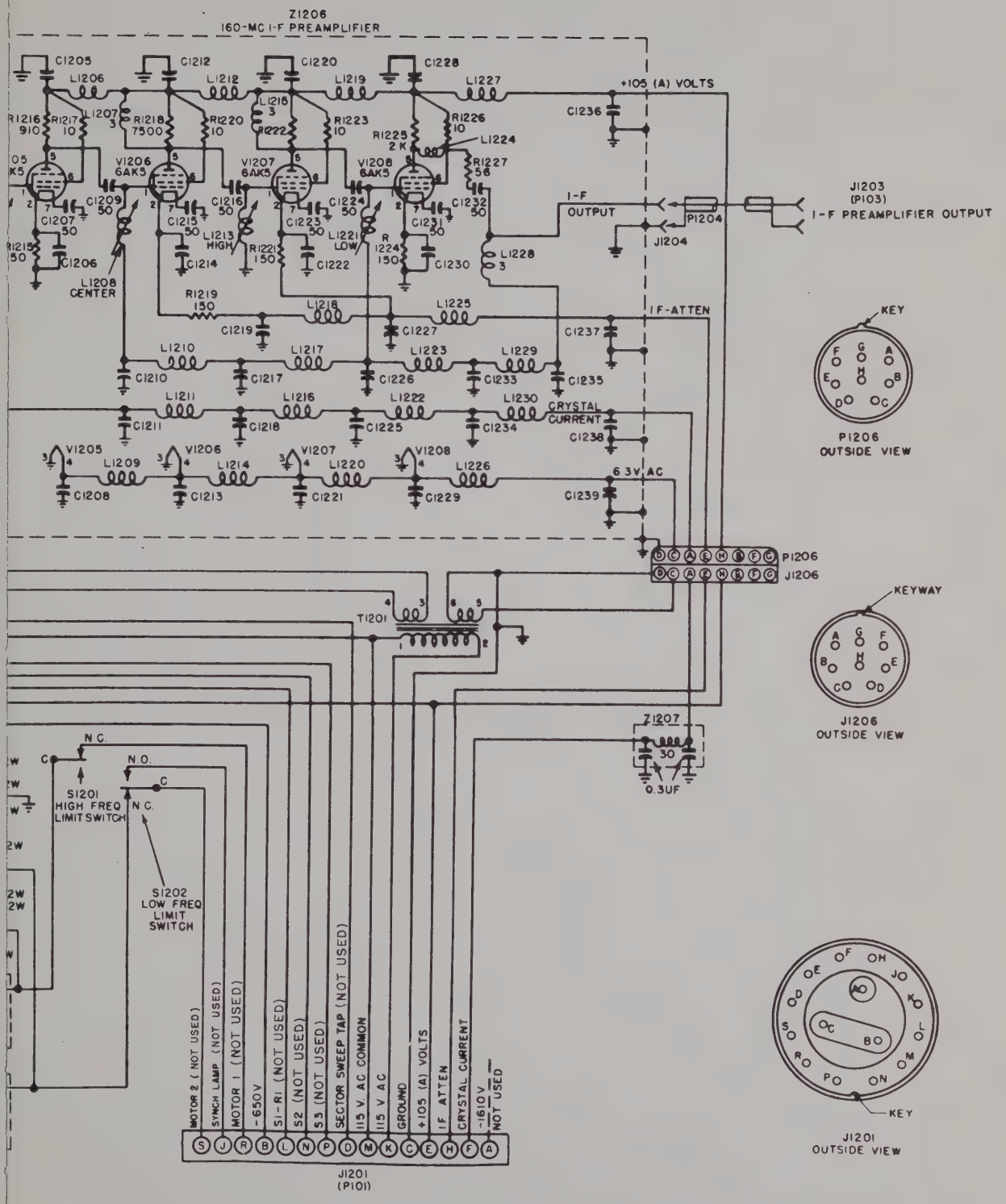

Figure 2-14, R-F Tuner TN-129C/APR-9, Schematic Diagram

may be set up, causing erratic operation of the oscillator within the tuning range, since higher order resonances having circumferential current flow can be excited within the plunger.

(d) Oscillator Output Coupling:

The coupling system used to extract power from the local oscillator consists of a small probe, fixed in position and located just inside the outer conductor near the tube end of the cavity. Further details of the coupling system can be found in sub-paragraph 3e(3).

(5) Mechanical Tuning System: (See Figure 2-14)

(a) General:

The mechanical tuning system gangs the tuning of the r-f preselector Z201, the counter dial N1201, the local oscillator Z203, the reflector voltage potentiometer R204, the sector sweep potentiometer R205, the synchro generator G1201, and the drive motor B201.

NOTE

TUNING MOTOR B201 IS DISENGAGED AT ALL TIMES DUE TO PLACEMENT OF A TUNING KNOB ON THE LOCAL TUNING CONTROL. SECTOR SWEEP POTENTIOMETER R205 AND SYNCHRO GENERATOR G201 ARE WITHOUT FUNCTIONS IN THE AN/URM-42 APPLICATION OF THE R-F TUNER.

Figure 2-14 is a complete schematic diagram of the TN-129C/APR-9 Tuner and shows the detailed parts of the system in schematic form. Figure 2-15 illustrates the mechanical linkage and the gear system used to drive the components.

(b) Mechanical Linkage:

The mechanical linkage and gearing is shown schematically in Figure 2-15. Except for the use of 18 eccentric studs on the preselector cam and physical differences because of the different frequency range covered, the operation of the mechanical linkage system is similar to that of the TN-128A/APR-9 (refer to subparagraph 3k(5) (b).

(6) I-F Preamplifier:

The theory of operation of the TN-129C/APR-9 i-f preamplifier is described in sub-paragraph 3g of this section.

(7) Reflector Voltage Network:

(See Figure 2-14). A voltage of -650 volts with respect to ground is provided for the reflex klystron. The reflector voltage network consists of three series-connected voltage regulator tubes V202, V203, and V204, together with resistors R203, R204, R206, and R207, also connected in series. The resistor circuit is shunted across the voltage regulator tube circuit. The resistive circuit provides the reflector-to-cathode voltage. The voltage regulator tubes maintain the voltage across the network constant so that the voltage between the cathode and the grounded resonator grids of the klystron is held at -280 volts. The moving arm of R204, connected through P207 and J207 to the reflector electrode of the klystron and tracked by the mechanical drive system, provides the correct voltage. R203 provides adjustment of the reflector voltage at the low-frequency end of the tuning range, while R206 provides adjustment at the high frequency end. Three test points J208, J209, and J210 are provided to check the voltages at the cathode and reflector electrodes of V201 and at the -650-volt input.

(8) Filament Voltage Circuit:

Filament voltage is furnished by transformer T201 from two secondary windings, one of which furnishes 6.3 volts to the heater of V201, the other 6.3 volts to V205, V206, V207, and V208. Plate voltage for the i-f preamplifier is furnished through J206 from the R-F Tuner Power Supply PP-1179/URM-42.

m. R-F Tuner TN-130A/APR-9:

(1) General:

Sub-paragraphs 3m(2) through 3m(8) contain information which is applicable to R-F Tuner TN-130A/URM-42 alone, and are a further development of sub-paragraphs 3a through 3j. Together these paragraphs present an overall discussion of the theory of operation of the TN-130A/APR-9. The unit covers the frequency range of 4300 to 7350 mc (4.30 to 7.35 kmc). The functional relationship of the major circuits is illustrated in Figure 2-2 and described in sub-paragraph 3b.

(2) R-F Preselector:

(See Figure 2-16). The preselector of R-F Tuner TN-130A/APR-9 consists of three overcoupled coaxial cavities, circular in cross section, with aperture-type coupling (refer to sub-paragraph 3c(3)) between cavities. To assure an i-f bandwidth of 20 mc, a preselector bandwidth of approximately 30 mc is provided at 4300 mc and approximately 60 mc at 7350 mc. The cavities operate as three-quarter wavelength resonant lines, open-circuited at one end and short-circuited at the other end. Noncontacting short-circuiting elements are used to eliminate tuning noise. (Refer to sub-paragraph 3c(2)). The plungers are tuned to the desired electrical length by axial movement of the center conductors which in effect changes the length of the cavities. The outer conductors of the cavities are formed by three holes bored through an aluminum block, which is fastened rigidly to the frame of the preselector. (See Figure 2-16). The plungers are mounted in a common supporting carriage which supports and maintains each plunger concentric within the noncontacting short-circuiting elements placed at the end of each cavity. Each conductor is independently

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NOTES.

1. All resistor values are in ohms unless followed by "K" - kilohm (1,000 ohms). Tolerance is ±5% and power rating is ½ watt unless otherwise indicated.
2. All capacitor values are in micromicrofarads - "UUF", unless followed by "UF" - microfarad, and are 1,000 UUF unless otherwise indicated.
3. All fixed inductor values are in microhenries - "UH" and are approximately 0.25 UH unless otherwise indicated.
4. Limit switches S1201 and S1202 are normally closed as shown.
5. Crystal holder is part of I-F Preamplifier Z1206.

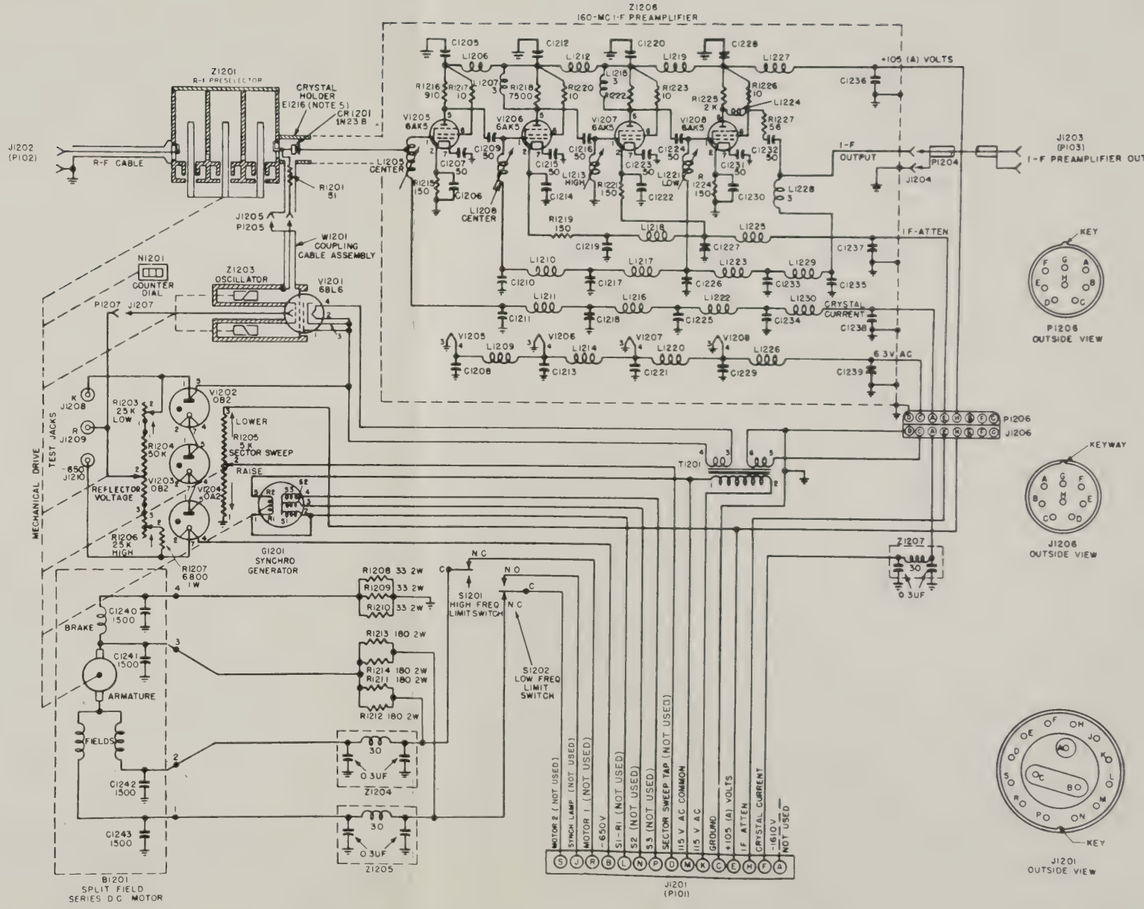


Figure 2-14, R-F Tuner TN-129C/APR-9, Schematic Diagram

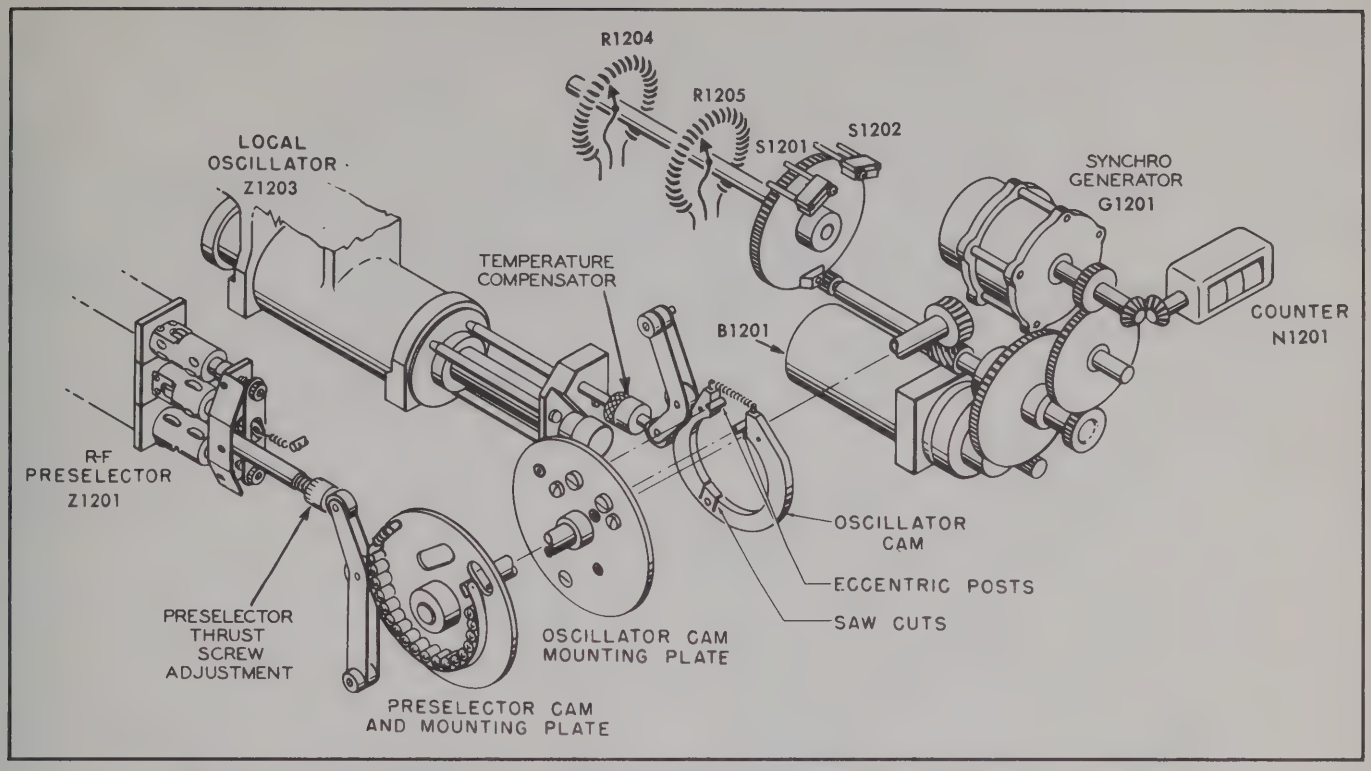


Figure 2-15, R-F Tuner TN-129C/APR-9, Mechanical Tuning Linkage, Schematic Diagram

adjustable in length by means of spring-loaded contacts between conical surfaces machined on the rear of each of the plungers, and cone-tipped adjusting screws, permitting initial alignment. These adjustments, placed in the carriage perpendicular to the axis of the center conductors, actuate the conductors by forcing the cone-shaped ends of the screws against the tapered ends of the conductors, which are loaded longitudinally by springs. The carriage is supported by three stainless steel balls which roll in the stainless steel guides adjustably mounted in the frame of the preselector. The carriage is driven from the preselector cam through a thrust screw. This thrust screw, which permits positioning of the carriage and the three center conductors as a unit, is adjusted during alignment of the preselector. In order to insure that the three cavities track together properly over the frequency range, four tracking screws are placed in each cavity. These screws are mounted in the cavity block perpendicular to the axis of the cavity and either protrude into the cavity or recede from it, depending on initial alignment. These screws compensate for distortion in the tuning characteristics caused by reactances introduced into the input and output cavities by the coupling devices and by variations in mechanical tolerances.

CAUTION

THESE SCREWS ARE COVERED WITH A PROTECTING PLATE AND MUST NOT BE TAMPERED WITH BY OPERATING, OR UNQUALIFIED MAINTENANCE, PERSONNEL.

(3) Crystal Mixer:

(See Figure 2-17). The r-f signal from the preselector Z301 is converted by the crystal mixer CR301 through combination of the r-f signal with the local oscillator signal generated by V301. The crystal mixer CR301 is a JAN-1N23B silicon crystal and is located behind the cap 0329 which serves as a shield. The local oscillator is a type 5721 reflex klystron. The i-f output voltage produced is fed to the i-f preamplifier Z303. The r-f signal from the preselector is picked up by a loop (part of coupling cable W301), which connects with the crystal tip jack. Power from the local oscillator Z302 is supplied through cable W301. A polyiron slug in the line between the oscillator Z302 and the r-f preselector serves as a decoupling and matching device. The 160-mc signal from the crystal is fed to the input circuit of the first i-f preamplifier stage through as short a lead as possible.

(4) Local Oscillator: (See Figure 2-18).

(a) General:

The local oscillator of R-F Tuner TN-130A/APR-9 uses a JAN-5721 reflex klystron. The oscillator tunes over the range from 4460 to 7510 mc, always 160 mc above the r-f signal frequency. The resonator is tuned by means of a noncontacting short-circuiting plunger. The reflector cathode voltage of the tube is variable and tracks with the movement of the plunger through a mechanical drive system. A pair of waveguide traps, installed

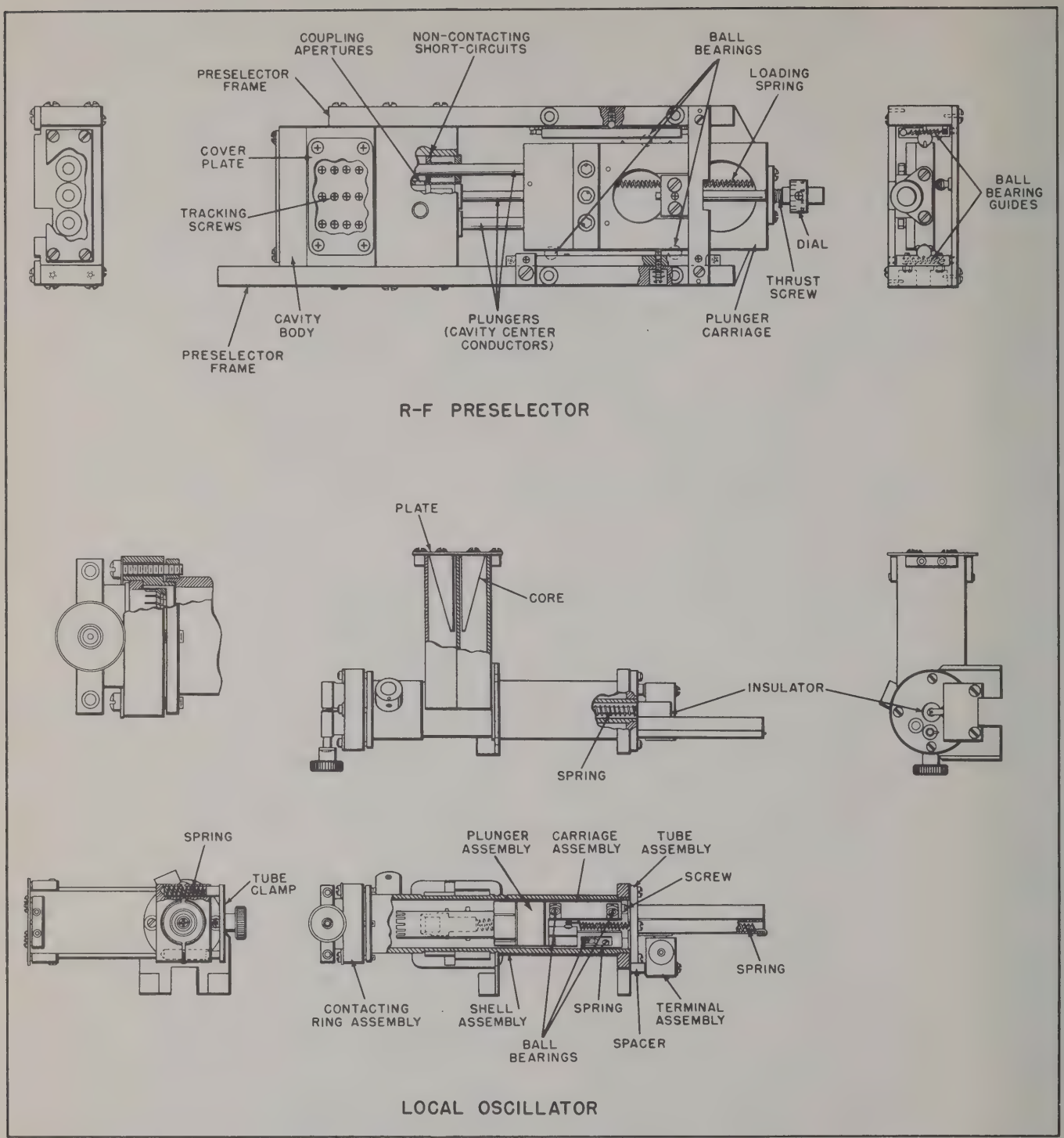


Figure 2-16, R-F Tuner TN-130A/APR-9, R-F Preselector and Local Oscillator, Cross-Sectional View

as an integral part of the cavity, function as spurious oscillation suppressors. (Refer to subparagraph 3e(2).) Power is extracted from the resonator by loop coupling. The oscillator power is delivered to the mixer where it is attenuated before it is applied to the crystal.

(b) Reflex Klystron:

Figure 2-18 illustrates the reflector transit mode characteristic of the JAN-5721 reflex klystron. The local oscillator operates throughout the frequency range on the 2-3/4-cycle reflector transit mode so that the reflector-to-cathode voltage varies from approximately -75 to -550 volts. The tube operates with a resonator grid potential of 1000 volts above the cathode, and with an average cathode current of 18 ma. For safety in handling, the resonator is grounded and the cathode operates at a negative potential.

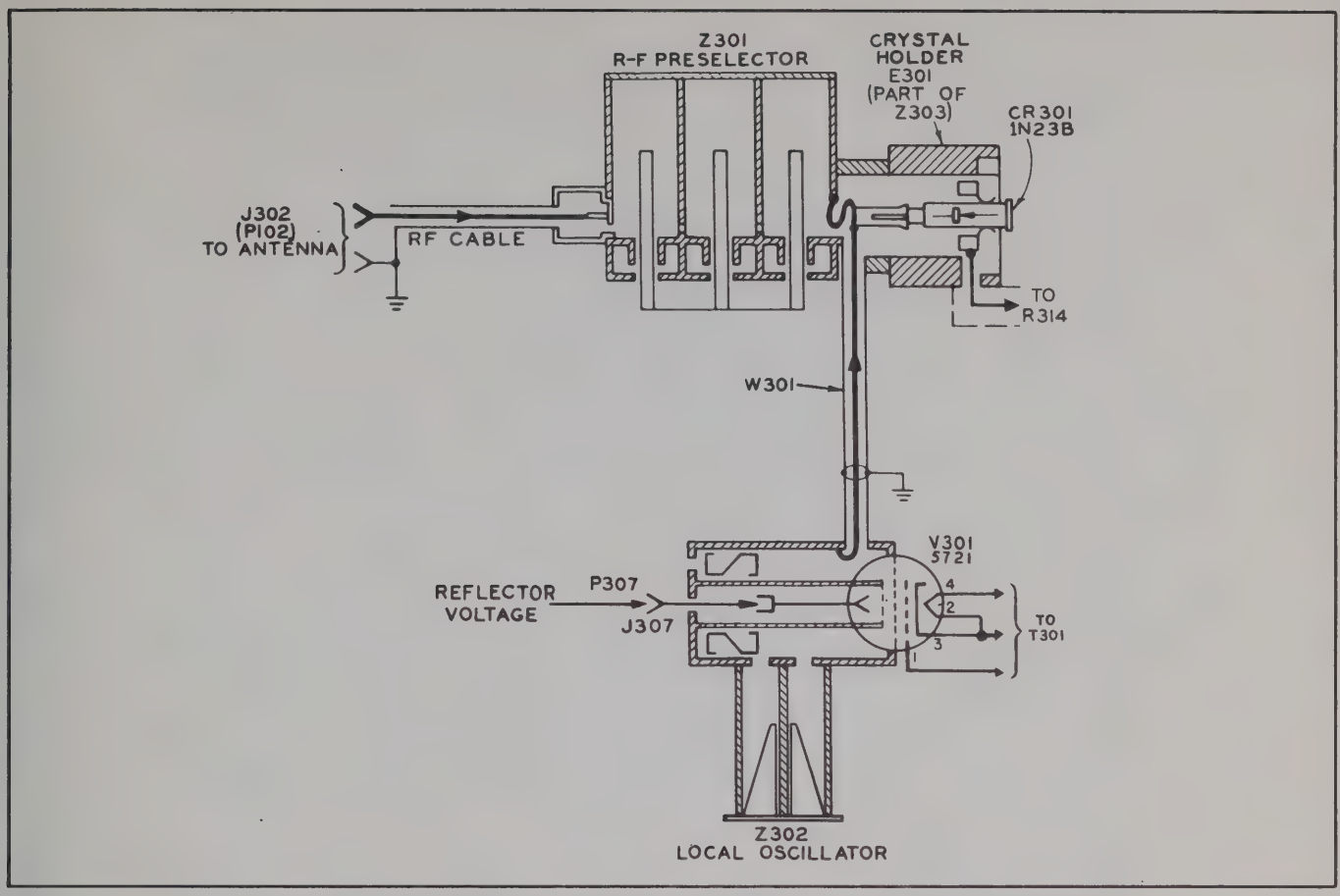


Figure 2-17, R-F Tuner TN-130A/APR-9, Input Circuit, Schematic Diagram

An additional grid (terminal 1) is used for purposes of current control. External connections to the grids are made through the tube base terminals and two gold-plated rings around the tube envelope. The external connection to the reflector is a socket-type cap at the top of the tube, connection to which is made by means of a single banana-type contact.

(c) Coaxial Cavity Resonator:

A general discussion of the theory of operation of coaxial cavity resonators is given in subparagraph 3e(2). In the TN-130A/APR-9 local oscillator, the length of the cavity is 3/4 wavelength at the operating frequency, and the 2-3/4 cycle reflector mode of the reflex klystron is used. The characteristics of the JAN-5721 reflex klystron are such that at tuning positions below approximately 5000 mc oscillation can occur not only in the 3/4-wavelength cavity mode, 2-3/4-cycle reflector mode, but also simultaneously in a 5/4-wavelength cavity mode, 4-1/4-cycle reflector mode. This latter undesired oscillation is a result of what is sometimes referred to as multi-frequency bunching effect. To prevent this abnormal oscillation from taking place, a pair of rectangular waveguide traps, loaded with lossy bakelite cores, are attached to the outer wall of the cavity. The waveguide traps differ in size and are so constructed that the larger waveguide has a cutoff frequency of approximately 5250 mc and the smaller waveguide has a cutoff frequency of approximately 5900 mc. At tuning positions below about 5000 mc, the local oscillator tuning plunger is in such a position that one or both of the waveguide apertures are open to the cavity. The desired oscillation occuring at such a tuning position is isolated from the lossy material in the waveguide traps since the guides are below cutoff for these frequencies. However, at the same tuning position, oscillation at a frequency above waveguide cutoff (corresponding to 5/4-wavelength cavity operation) is prevented since the lossy bakelite cores of the waveguides are closely coupled to the cavity at such a frequency and degrade the Q of the cavity to such an extent that the undesired oscillation cannot take place. As the R-F Tuner is tuned toward the higher end of its frequency range, the tuning plunger advances, gradually closing off first one, then the other waveguide aperture, until finally both are covered by the tuning plunger. In tuning positions above approximately 5500 mc, therefore, the waveguides are no longer coupled to the cavity and the desired oscillation is not adversely affected by the lossy material.

Preliminary positioning of the local oscillator

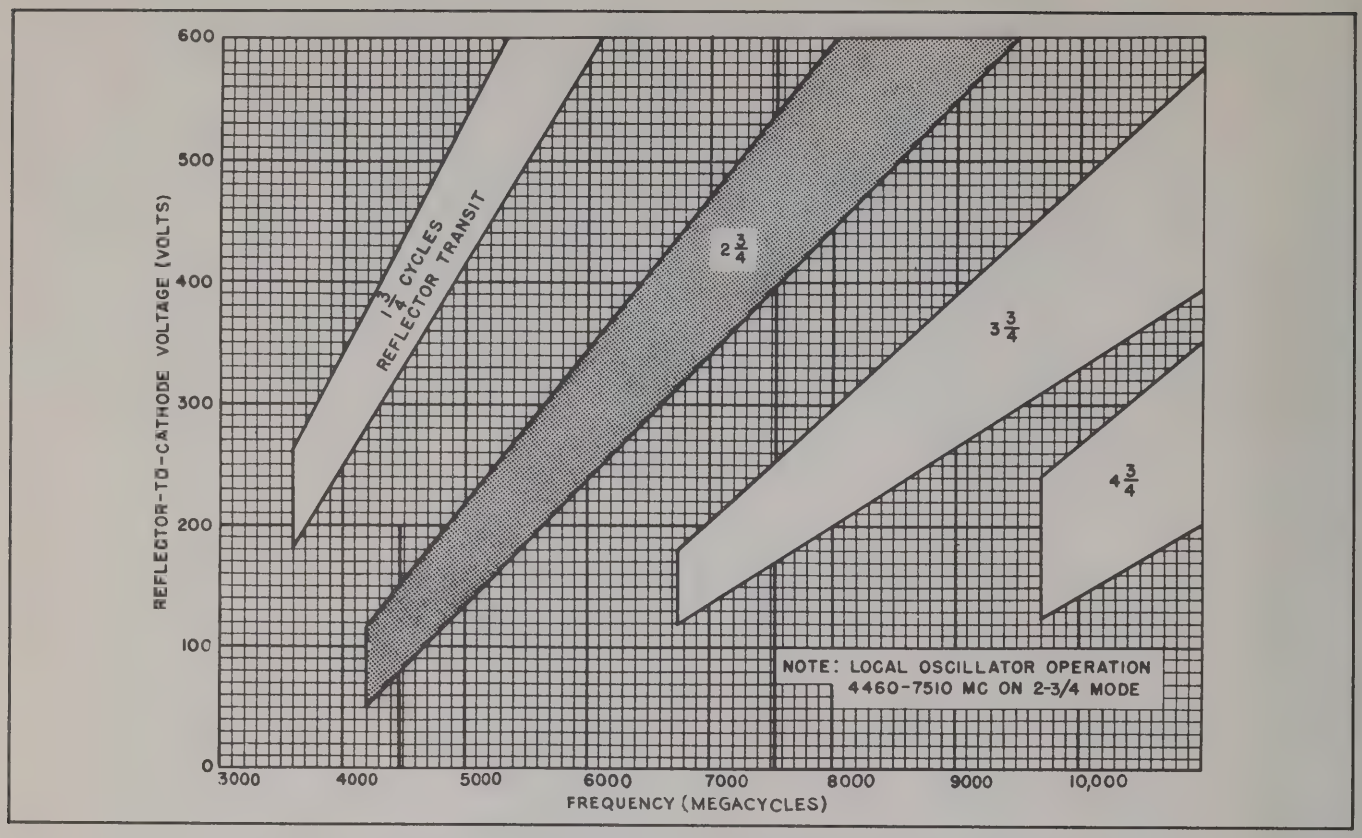


Figure 2-18, Reflector Transit Mode Characteristic of JAN-5721 Reflex Klystron

tube V301 in the cavity is done by means of spring-finger contacts on the center conductor of the cavity engaging the first resonator grid ring as the tube is inserted into the cavity. Final positioning of V301 is accomplished by spring-finger contacts on the outer conductors of the cavity seating against the shoulder of the first resonator grid ring. A collet-clamp attached to the cavity tightened by a knurled thumb screw secures the tube in position. A banana-type contact, to which the reflector voltage is connected, automatically engages the socket of the reflex klystron reflector cap. A spring-loaded insulating cap covers this junction, to reduce the danger of voltage breakdown.

The oscillator is tuned by means of a non-contacting short-circuiting plunger. (See Figure 2-5.) The plunger contains five axial slots cut through its front section and equally spaced to place any circumferentially propagated modes, which might be excited in the plunger gaps, outside the frequency range of the oscillator. The tuning plunger is supported by a single carriage on which it is mounted. This carriage is supported by five ball bearing wheels, two pairs of which are in the same plane, while the remaining one is in the center. The four bearings in the same plane are fixed in position, though adjustable during assembly for accurately centering the plunger in the cavity. The remaining bearing is spring-loaded radially inward. These bearings roll on the cavity center conductor. The plunger is driven by a driving rod, inserted into a driver guide tube, bearing against the plunger assembly. The plunger assembly is spring-loaded against the driving rod by a spring, attached to the plunger, and to the outer end of a guide tube extending from the rear of the cavity assembly.

Power is extracted from the cavity resonator by loop coupling at a fixed point in the cavity. Further details can be found in paragraph 3e(3).

(5) Mechanical Tuning System:

(a) General:

The mechanical tuning system of R-F Tuner TN-130A/APR-9 consists of suitable gears and cams ganging the tuning of the r-f preselector Z301, counter dial N301, local oscillator Z302, reflector voltage potentiometer R331, sector sweep potentiometer R328, synchro generator G301, and tuning motor B301.

NOTE

TUNING MOTOR B301 IS DISENGAGED AT ALL TIMES DUE TO PLACEMENT OF A TUNING KNOB ON THE LOCAL TUNING CONTROL. SECTOR SWEEP POTENTIOMETER R328 AND SYNCHRO GENERATOR G301 ARE WITHOUT FUNCTIONS IN THE AN/URM-42 APPLICATION OF THE R-F TUNER.

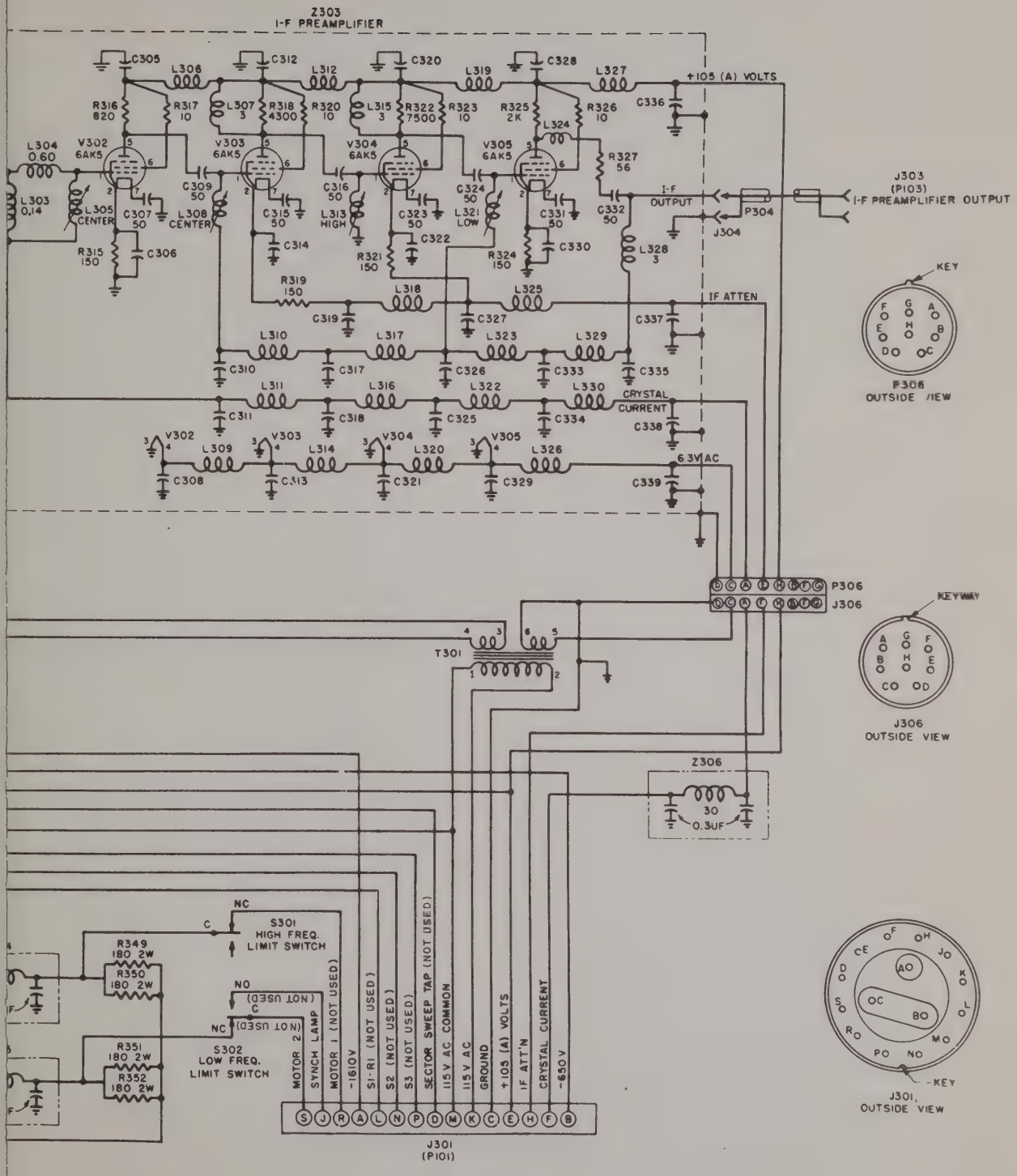


Figure 2-19, R-F Tuner TN-130A/APR-9 Schematic Diagram

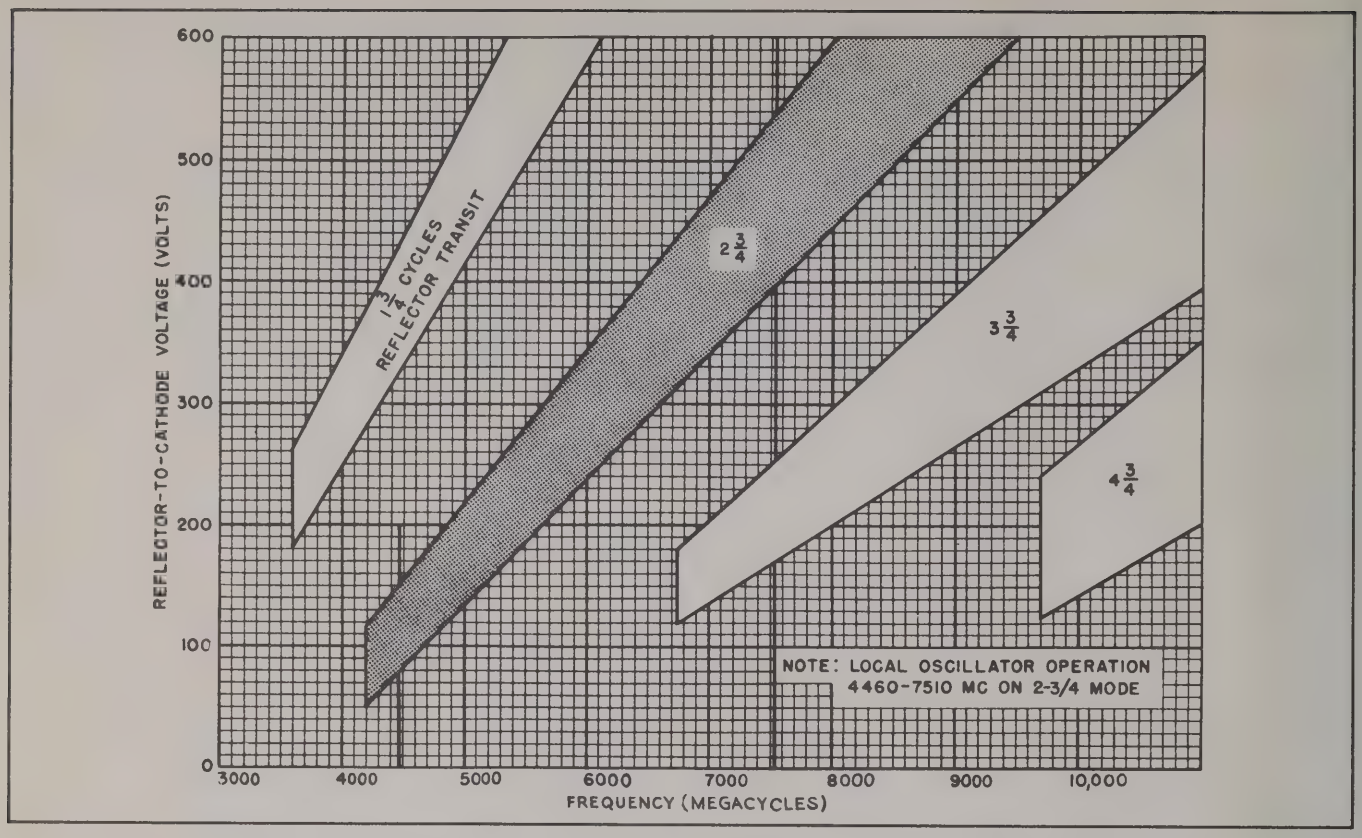


Figure 2-18, Reflector Transit Mode Characteristic of JAN-5721 Reflex Klystron

tube V301 in the cavity is done by means of spring-finger contacts on the center conductor of the cavity engaging the first resonator grid ring as the tube is inserted into the cavity. Final positioning of V301 is accomplished by spring-finger contacts on the outer conductors of the cavity seating against the shoulder of the first resonator grid ring. A collet-clamp attached to the cavity tightened by a knurled thumb screw secures the tube in position. A banana-type contact, to which the reflector voltage is connected, automatically engages the socket of the reflex klystron reflector cap. A spring-loaded insulating cap covers this junction, to reduce the danger of voltage breakdown.

The oscillator is tuned by means of a non-contacting short-circuiting plunger. (See Figure 2-5.) The plunger contains five axial slots cut through its front section and equally spaced to place any circumferentially propagated modes, which might be excited in the plunger gaps, outside the frequency range of the oscillator. The tuning plunger is supported by a single carriage on which it is mounted. This carriage is supported by five ball bearing wheels, two pairs of which are in the same plane, while the remaining one is in the center. The four bearings in the same plane are fixed in position, though adjustable during assembly for accurately centering the plunger in the cavity. The remaining bearing is spring-loaded radially inward. These bearings roll on the cavity center conductor. The plunger is driven by a driving rod, inserted into a driver guide tube, bearing against the plunger assembly. The plunger assembly is spring-loaded against the driving rod by a spring, attached to the plunger, and to the outer end of a guide tube extending from the rear of the cavity assembly.

Power is extracted from the cavity resonator by loop coupling at a fixed point in the cavity. Further details can be found in paragraph 3e(3).

(5) Mechanical Tuning System:

(a) General:

The mechanical tuning system of R-F Tuner TN-130A/APR-9 consists of suitable gears and cams ganging the tuning of the r-f preselector Z301, counter dial N301, local oscillator Z302, reflector voltage potentiometer R331, sector sweep potentiometer R328, synchro generator G301, and tuning motor B301.

NOTE

TUNING MOTOR B301 IS DISENGAGED AT ALL TIMES DUE TO PLACEMENT OF A TUNING KNOB ON THE LOCAL TUNING CONTROL. SECTOR SWEEP POTENTIOMETER R328 AND SYNCHRO GENERATOR G301 ARE WITHOUT FUNCTIONS IN THE AN/URM-42 APPLICATION OF THE R-F TUNER.

NAVSHIPS 92363
AN/URM-42

NOTES:

1. All resistor values are in ohms unless followed by "K" - kilohm (1,000 ohms). Tolerance is ± 5% and power rating is ½ watt unless otherwise indicated.
2. All capacitor values are in micromicrofarads - "UUF", unless followed by "UF" - microfarad, and are 1,000 UUF unless otherwise indicated.
3. All fixed inductor values are in microhenries - "UH" and are approximately 0.25 UH unless otherwise indicated.
4. Limit switches S301 and S302 are normally closed as shown.
5. Crystal holder is part of I-F Preamplifier Z303.

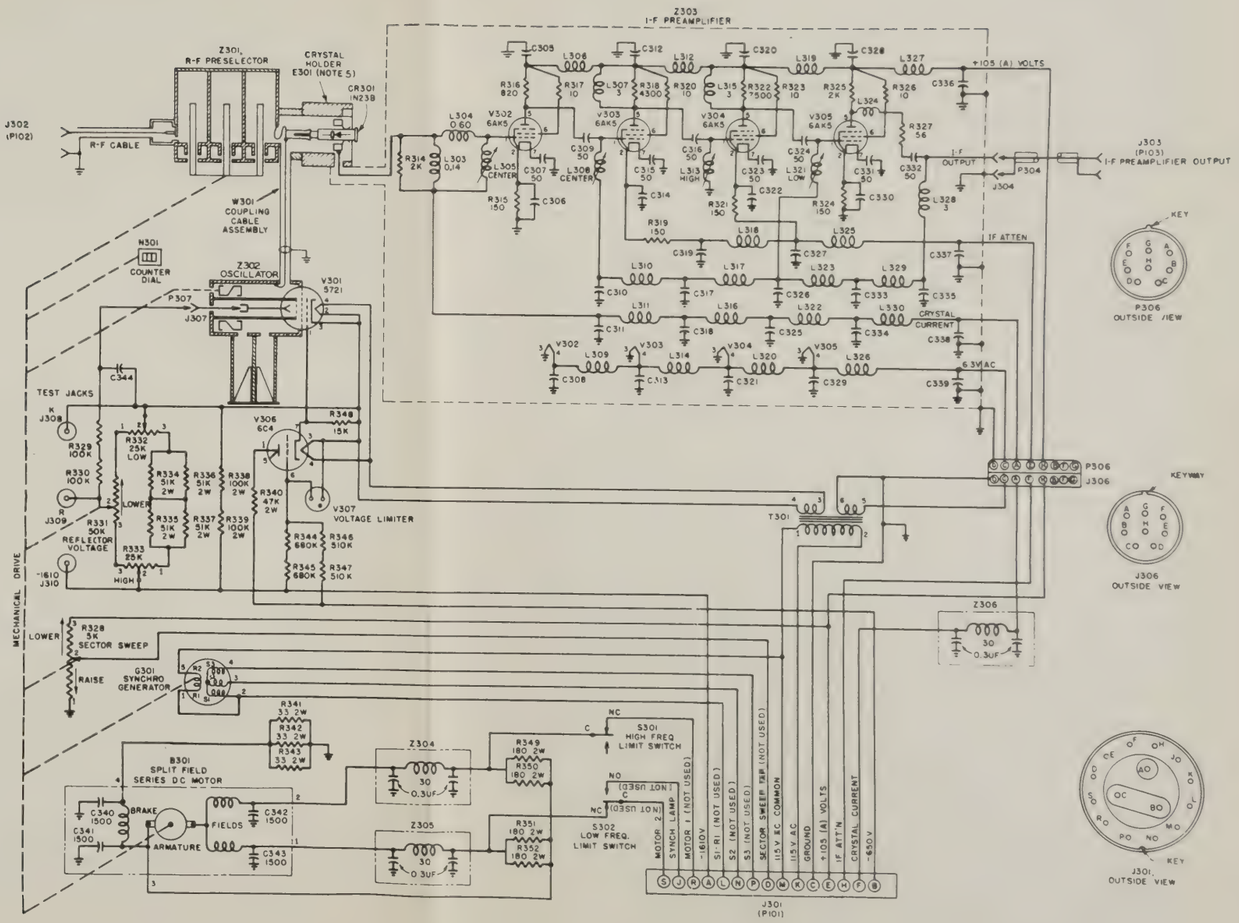


Figure 2-19, R-F Tuner TN-130A/APR-9 Schematic Diagram

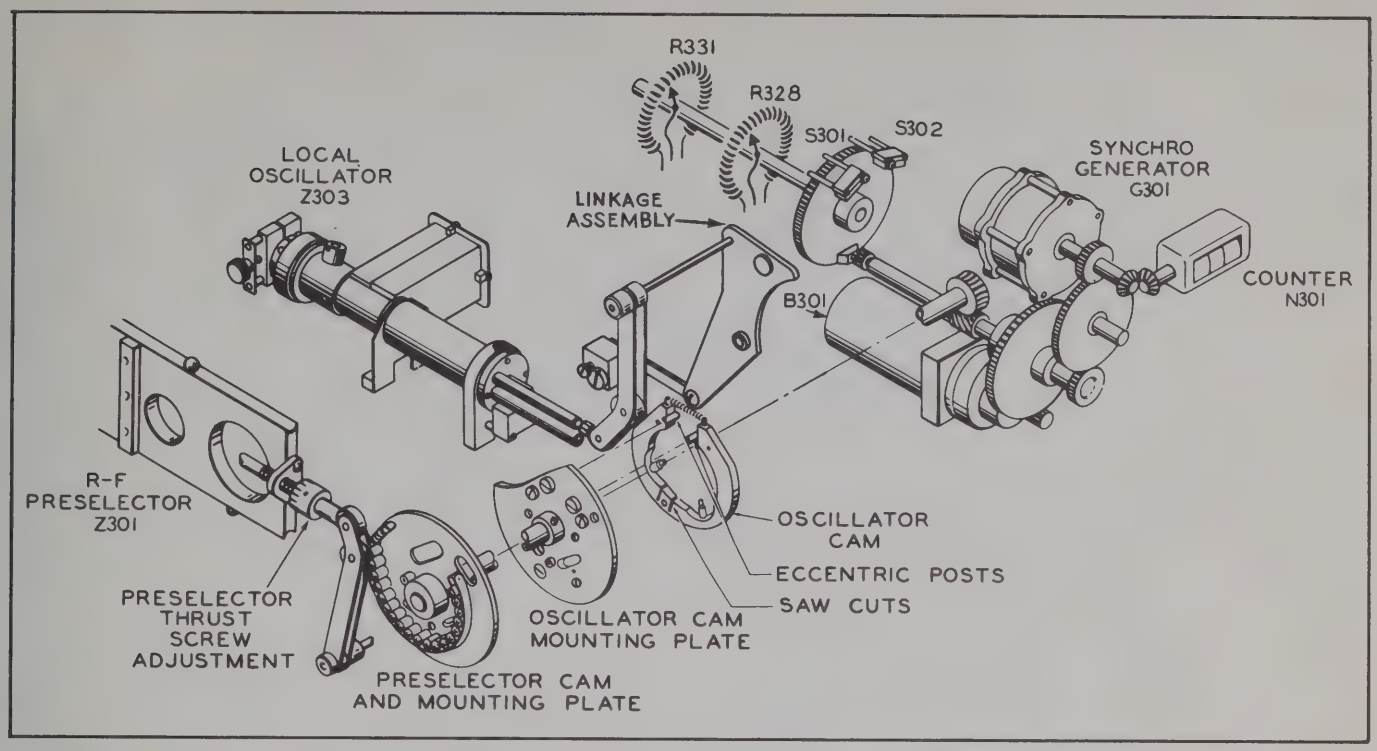


Figure 2-20, R-F Tuner TN-130A/APR-9, Mechanical Tuning Linkage, Schematic Diagram

Figure 2-19 is a schematic diagram of the TN-130A/APR-9 R-F Tuner and shows the detailed elements of this system. Figure 2-20 is a schematic diagram of the gear system used to drive the tunable parts of the system and shows the cam system used to convert the linear wavelength tuning of the local oscillator and preselector to a rotary linear frequency variation.

(b) Mechanical Linkage:

The mechanical linkage and gearing is shown in Figure 2-20. Drive motor B301 is disengaged by a clutch mechanism which is actuated by a pin extending from the tip of the local tuning control shaft. This pin is actuated at all times by the knob on the front panel end of the shaft. The main drive shaft is driven by the front panel knob. The front end of the drive shaft is geared to the synchro generator G301 and the counter N301. The rear end of the shaft is geared to R331 and R328 through a gear which also operates the limit switches S301 and S302. These switches are without functions in that the motor is disengaged from the drive shaft and does not have power applied to its windings. A worm thread on the main drive shaft turns a worm gear which activates the oscillator and preselector cams.

(c) Oscillator and Preselector Cams:

The preselector cam and the oscillator cam are mounted on a common shaft, with the oscillator cam mounted directly behind the preselector cam. As the cams rotate, due to the gear motion initiated by the front panel tuning control, the local oscillator tuning plunger and the preselector tuning carriage are actuated through pivoting lever arms 0316 and 0317. Each lever arm contains two rollers, one riding on the face of the cam, the other driving the tuning mechanism. Since the rotation of the cams' drive shaft is linearly proportional to frequency, the cams are shaped to transform the approximately linear-wavelength-versus-cavity-length tuning of the oscillator and preselector to a linear frequency tuning, while tracking them with each other and with the frequency-indicating counter N301.

(d) Oscillator Tracking Adjustments:

The contour of the oscillator cam face may be adjusted by small amounts in order to accomodate all JAN-5721 reflex klystrons which require, within manufacturing tolerances, some variation in plunger position for a fixed oscillation frequency. For this purpose four independent frequency adjustments are provided: a low, and intermediate-low, a high, and an intermediate-high. The low- and high-frequency adjustments are eccentric in shape and are provided for each extreme end of the frequency range. The intermediate-low and intermediate-high frequency adjustments are hexagonal screws and are provided for fine adjustments within the frequency range. All adjustments are accessible through slots cut through the preselector cam mounting plate and are adjusted by either a screw driver of a 1/8-inch hexagonal wrench. Turning the intermediate adjustment screws clockwise will increase the oscillator frequency. An engraved dot on each eccentric adjusting shaft indicates the direction

of maximum throw of the eccentric. The oscillator frequency is increased as the dot moves toward the rear of the unit. In effect, screwing the hex adjustment screws in, or tuning the eccentric so that the dot moves toward the rear of the TN-130A/APR-9, pushes the cam out and shortens the cavity, thereby increasing the frequency. When the high-frequency eccentric or the intermediate-high frequency adjustment screw is rotated, the contour of the upper-frequency half of the cam-face length is varied, and when the low-frequency eccentric or the intermediate-low frequency adjustment screw is rotated, the lower-frequency half of the cam-face length is varied, each adjustment being independent. Another independent oscillator tracking adjustment is provided by the linkage mechanism which permits adjustment of the position of the top pivot bearing for the oscillator tuning arm. This top bearing is mounted at the top of a flat plate which is pivoted on a fixed post at a point slightly below center. The lower end of the plate is connected by an invar strap to an eccentric shaft, equipped with a screw-driver slot, which is mounted in a fixed post on the R-F Tuner base below the oscillator cavity. Rotation of this eccentric moves the plate, and thereby, the top bearing for the arm; as the top bearing moves in one direction the lower arm roller moves in the opposite direction, thus, changing the plunger position in the cavity. Rotating the eccentric shaft so as to move the engraved dot on its face toward the rear of the unit has the effect of pushing the plunger deeper into the cavity and thus, raising the oscillator frequency. Still another independent adjustment of plunger position (used only in factory assembly) is provided by the hexagonal nut (with locknut) on the end of the oscillator plunger driving rod. This adjustment is made at the center frequency of the tuning range. Except for the intermediate adjustments, independent locking screws are provided for all adjustments. The intermediate adjustments are secured against accidental rotation by elastic nylon pins engaging the threads of the screws. The invar strap which connects the linkage plate with the eccentric adjusting shaft is of such length as to provide (in co-operation with the aluminum of the frame and base casting), whenever a temperature change occurs, an opposing motion of the plunger in the cavity to reduce oscillator frequency shifts resulting from such temperature changes to a very low value.

(e) Preselector Tracking Adjustments:

The contour of the preselector cam face consists of a flexible strip of metal stretched tightly over a series of 19 eccentric studs which are spaced equally around the periphery of the cam. Each stud may be rotated by inserting the special wrench provided into a slot cut in one end of the stud. When a stud is rotated, the cam radius at that point is varied as a result of the stud eccentricity. Hence, multipoint independent adjustment of the cam shape is available, providing accurate tracking of the preselector with the oscillator over the entire frequency range. In addition, a thumb-screw adjustment, similar to the hex-head adjustment screw used on the local oscillator, is provided to facilitate alignment and testing of the preselector. All adjustments on the preselector cam are provided with central locking screws.

(6) I-F Preamplifier:

(See Figure 2-19.) The theory of operation of the TN-130A/APR-9 i-f preamplifier is discussed in sub-paragraph 3g. The input circuit of this preamplifier differs only in that R314, L303, and L304 have been added. This network is an impedance step-up circuit designed to improve the sensitivity and noise figure, and to broaden the tuning of the input stage.

(7) Reflector Voltage Network:

The beam voltage of the JAN-5721 reflex klystron V301 is approximately -1060 volts, and the cathode current approximately 17.5 ma. These current and voltage values are automatically provided, practically independent of variations in the characteristics of V301, through the use of a current and voltage regulator circuit shown schematically in Figure 2-21.

Referring to Figure 2-21, the klystron cathode current flows through the resistive network composed of R331 through R339. The effective resistance of this network, from the cathode terminal (terminal 3) of V301 to the -1610-volt supply line, is approximately 31.5 K ohms. Consequently, if the cathode current of 17.5 ma flows through this network, the voltage drop across it will be about 550 volts, and the beam voltage will be 1060 volts.

The regulator circuit employs the control grid of V301 to set this voltage and current automatically, in the following manner. The design of V301 is such that for 17.5 ma cathode current the control grid must be set somewhere between 0 and 10

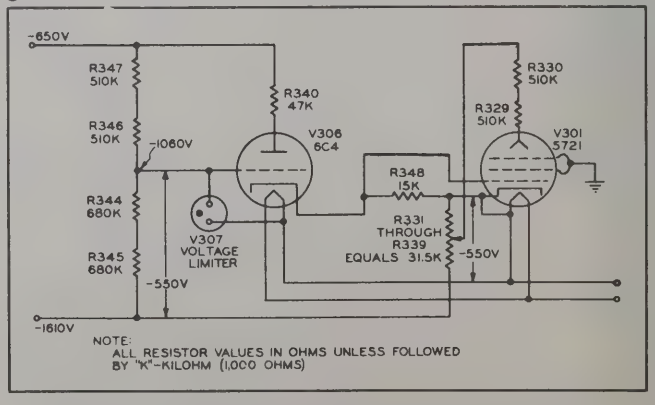
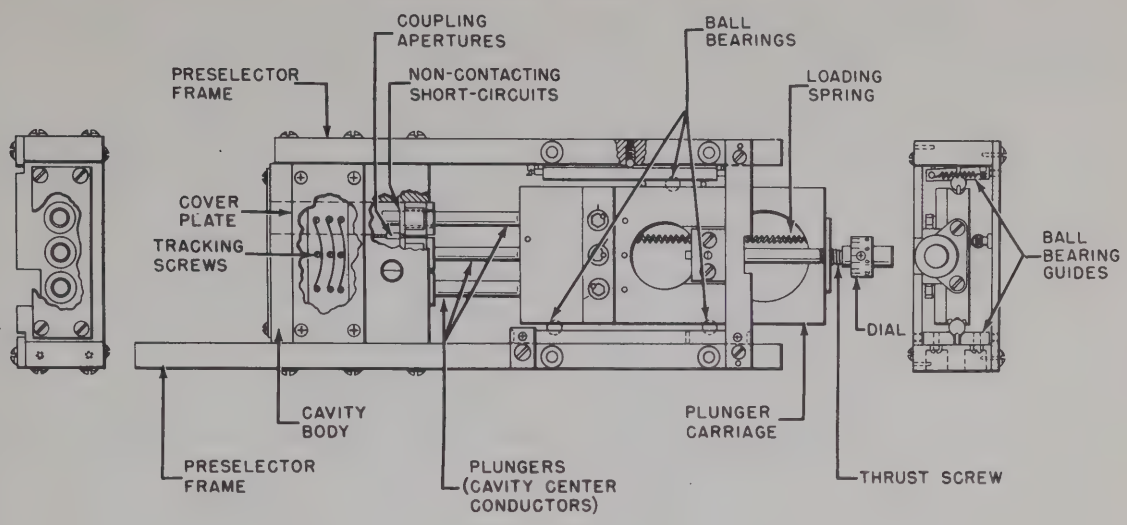
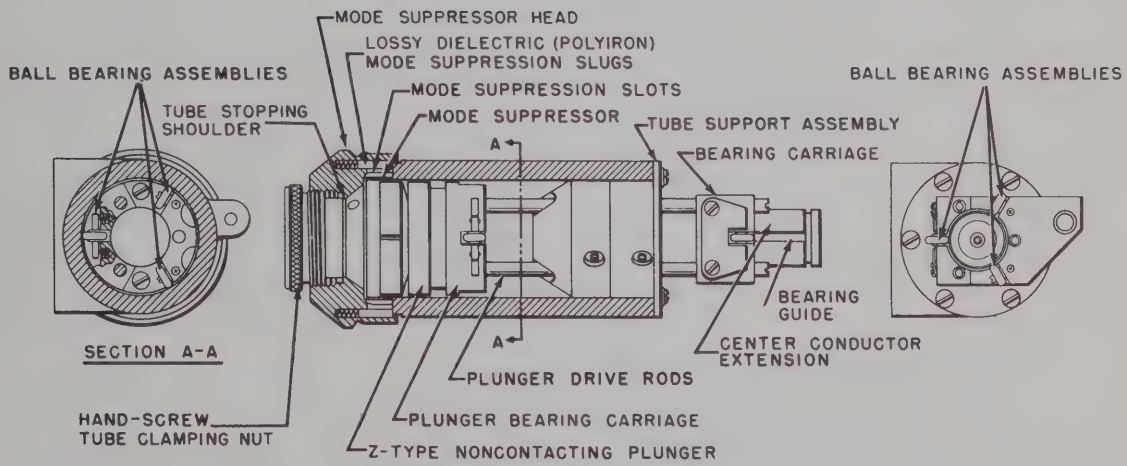


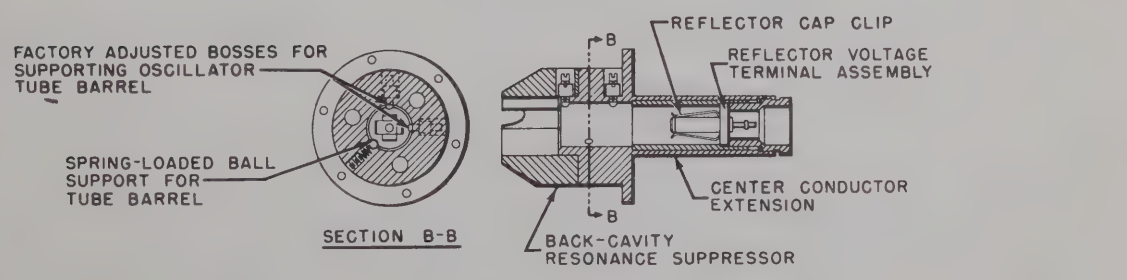
Figure 2-21, R-F Tuner TN-130A/APR-9, Reflector Voltage Network, Simplified Schematic Diagram



R-F PRESELECTOR



OSCILLATOR CAVITY ASSEMBLY



SUPPORT ASSEMBLY

LOCAL OSCILLATOR

Figure 2-22, R-F Tuner TN-131B/APR-9, R-F Preselector and Local Oscillator, Cross-Sectional View

volts positive with respect to the cathode. That is, the control grid and cathode are at almost equal voltage with respect to ground, since they will differ by less than ten volts in a thousand. Therefore, all that is required to establish the cathode potential at -1060 volts is to set the control grid voltage to an approximately equal value, under which conditions the cathode current of the tube will rise until the cathode and grid voltages are only a few volts apart. The control grid (terminal 1) of V301 is held at a potential of about -1060 volts by connecting it as the cathode load of the cathode follower tube V306. The grid of V306 is maintained at about -1060 volts by the voltage dividing network comprising R344 through R347. This network is connected between the voltage-regulated supply lines at -650 volts and -1610 volts as shown in Figure 2-24. Normally, V306 operates with its grid slightly negative with respect to its cathode so that no grid current is drawn. Consequently, the grid-voltage resistance network can employ high values of resistance thereby drawing very low bleeder current from the power supply. The cathode follower tube V306 thus acts as an impedance transformer to supply -1060 volts from a high-impedance source to the low-impedance load represented by the control grid of V301. The use of V306 is necessitated by the fact that the design of the JAN-5721 reflex klystron is such that its control grid always draws grid current under operating conditions. If the JAN-5721 had been designed for negative-grid operation, V306 could have been omitted and the grid of V301 tied directly to a voltage divider network.

V307 is a neon glow lamp which affords voltage protection to V306 during the warm-up period of V301. If, as during the warm-up period or in case of filament burnout, V301 is incapable of passing current, the voltage across its cathode resistance (R331 through R339) will be very low. Consequently, the cathode of V306, which is connected to the cathode of V301 through a protective resistor R348, would be several hundred volts negative with respect to its grid. However, V307 ignites when the voltage across it reaches approximately 80 volts. It, therefore, limits the grid-cathode current through R346 and R347. Normally, V307 lights when the power is first turned on and then goes out as V306 and V301 warm up.

Reflector voltage for V301 is obtained from a movable tap on R331, which is a part of the cathode resistance network of V301. (See Figure 2-19.) The tap position is mechanically varied by the tuning mechanism as to insure proper reflector voltage for each operating frequency. This voltage value varies from approximately -75 to -550 volts. Variable resistors R332 and R333 are used to adjust the potentials at the two ends of R331 to the proper values required by variations in the reflector characteristics of the JAN-5721 reflex klystron.

(8) Filament Voltage Circuit:

Filament voltage is furnished by transformer T301 from two secondaries, one of which furnishes 6.3 volts to the heaters of V301 and V306, the other 6.3 volts to V302, V303, V304, and V305. Plate voltage is furnished through J301 from the R-F Tuner Power Supply PP-1179/URM-42.

n. R-F Tuner TN-131B/APR-9:

(1) General:

Sub-paragraphs 3n(2) through 3n(8) contain information which is applicable to R-F Tuner TN-131B/URM-42 alone, and are a further development of sub-paragraphs 3a through 3j. Together these paragraphs present an overall discussion of the theory of operation of the unit. TN-131B/URM-42 covers the frequency range of 7,050 to 10,750 mc (7.05 to 10.75 kmc). The functional relationship of the major circuits is illustrated in Figure 2-2 and described in sub-paragraph 3b.

(2) R-F Preselector:

(See Figure 2-22.) The preselector of R-F Tuner TN-131B/APR-9 consists of three overcoupled coaxial cavities, circular in cross section, with aperture-type coupling (refer to sub-paragraph 3c(3)) between cavities. To assure an i-f bandwidth of 20 mc, a preselector bandwidth of approximately 35 mc is provided at 7,050 mc and about 70 mc at 10,750 mc. The cavities operate as three-quarter wavelength resonant lines, open-circuited at one end and short-circuited at the other end. Noncontacting short-circuiting elements are used to eliminate tuning noise. (Refer to paragraph 3c(2).) The plungers are tuned to the desired electrical length by axial movement of the center conductors, which, in effect, changes the length of the cavities. The outer conductors of the cavities are formed by three holes bored through an aluminum block, which is fastened rigidly to the frame of the preselector. (See Figure 2-22). The plungers are mounted in a common supporting carriage which supports and maintains each plunger concentric within the noncontacting short-circuiting elements placed at the end of each cavity. Each conductor is independently adjustable in length by means of spring-loaded contacts between conical surfaces machined on the rear of each of the plungers, and by cone-tipped adjusting screws, permitting initial alignment. These adjustments, placed in the carriage perpendicular to the axis of the center conductors, actuate the conductors by forcing the cone-shaped ends of the screws against the tapered ends of the conductors, which are loaded longitudinally by springs. The carriage is supported by three stainless steel balls which roll in the stainless steel guides adjustably mounted in the

frame of the preselector. The carriage is driven from the preselector cam through a thrust screw. This thrust screw permits positioning of the carriage and the three center conductors as a unit and is adjusted during alignment of the preselector. In order to insure that the three cavities track together, properly over the frequency range, three tracking screws are placed in each cavity. These screws are mounted in the cavity block perpendicular to the axis of the cavities and either protrude into the cavity or recede from it, depending on initial alignment. These screws compensate for distortion in the tuning characteristics caused by reactances introduced into the input and output cavities by the coupling devices and by variations in mechanical tolerances.

CAUTION

THESE SCREWS ARE COVERED WITH A PROTECTIVE PLATE AND MUST NOT BE TAMPERED WITH BY OPERATING, OR UNAUTHORIZED MAINTENANCE, PERSONNEL.

(3) Crystal Mixer:

(See Figure 2-23.) The r-f signal from the preselector Z401 is converted by the crystal mixer, a type JAN-1N26 silicon crystal through the combination of the r-f signal with the local oscillator signal generated by V401, a type USN-2K48 reflex klystron. The i-f output voltage produced is fed to the i-f preamplifier Z406. CR401 is located behind the cap 0428 which provides shielding for the crystal. The r-f signal from the preselector is picked up by a loop (part of cable W401) which connects with the crystal tip jack. Power from Z403, the local oscillator, is supplied through W401, and P405 into J405, in parallel with the r-f signal. A decoupling network, built into the mixer to present a high impedance at the point where power from Z403 is introduced, controls the amount of local oscillator power fed to the crystal and terminates the local oscillator-to-mixer coupling cable assembly W401. The network consists of a section of concentric line of a characteristic impedance considerably greater than that of the local oscillator-to-mixer cable. This section of line, located at the mixer end of the local oscillator feed, is made one-quarter wavelength at the mid-band frequency. A lossy dielectric bushing (carbon-impregnated bakelite) terminates the high-impedance line at the cable end of the line in a low impedance, thus, reflecting a relatively high impedance to the r-f signal at the local oscillator-signal input junction. The lossy dielectric bushing, together with a similar bushing located at the local oscillator output coupling loop, serves also to attentuate the local oscillator power to the desired mixer level. The 160-mc i-f output signal from the crystal is fed to the input circuit of the first i-f preamplifier stage through as short a lead as possible. The i-f voltage is developed across an r-f bypass capacitor,

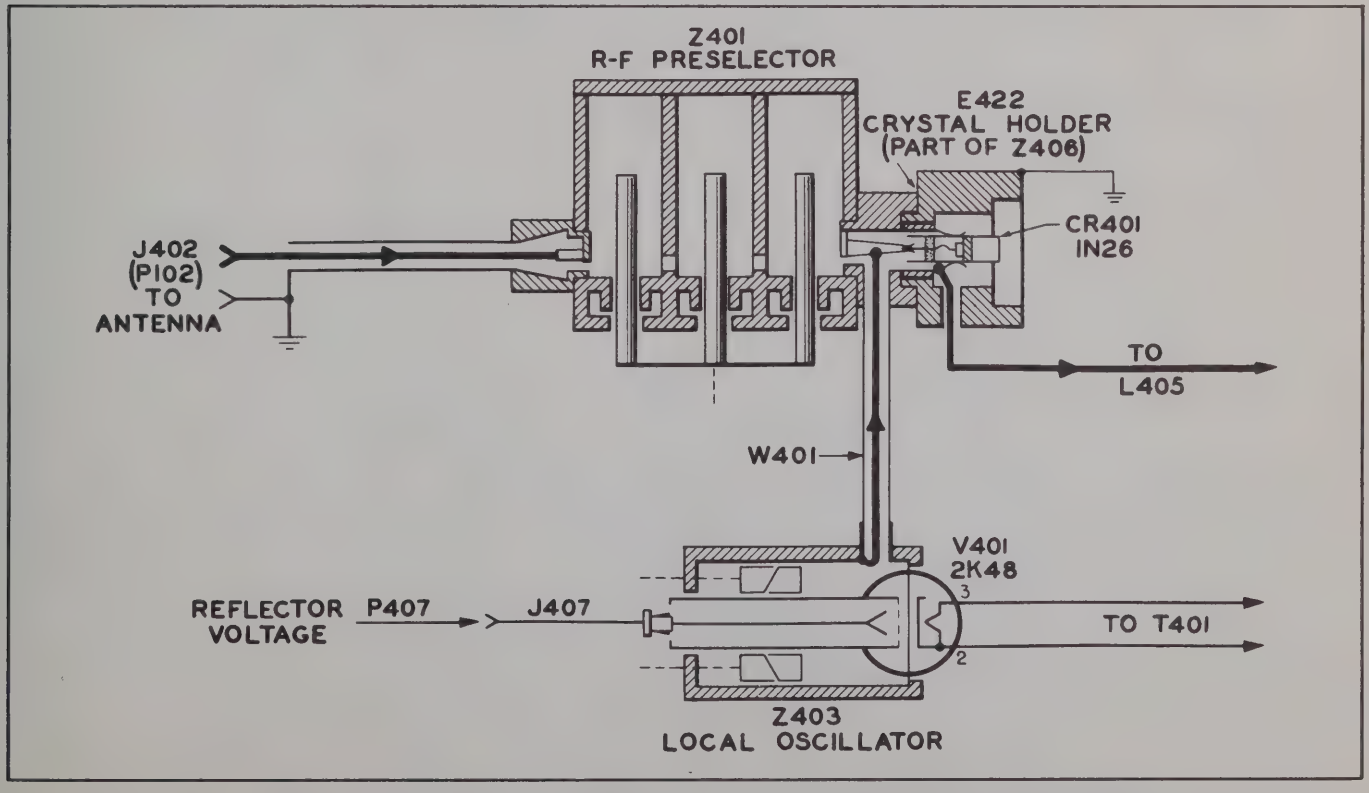


Figure 2-23, R-F Tuner TN-131B/APR-9, Input Circuit, Schematic Diagram

built into the mixer, which is of such a size as to present a low impedance to the r-f signal and a high impedance to the i-f signal.

(4) Local Oscillator: (See Figure 2-23.)

(a) General:

The local oscillator of R-F Tuner TN-131B/APR-9 uses a USN-2K48 reflex klystron V401 designed specifically for use with an external coaxial cavity resonator. The oscillator tunes over the range from 6890 to 10,590 mc, always at 160 mc below the r-f signal frequency. The resonator is tuned by means of a noncontacting short-circuiting plunger. The reflector-to-cathode voltage of the tube is variable and tracks with the movement of the plunger through a mechanical drive system. Power is extracted from the resonator by loop coupling. The oscillator power is delivered to the mixer, where it is attentuated before it is applied to the crystal.

(b) Reflex Klystron:

Figure 2-24 shows the reflector transit mode characteristic of the USN-2K48 reflex klystron. The local oscillator operates throughout the frequency range on the 3-3/4-cycle reflector transit mode so that the reflector-to-cathode voltage varies from about -75 to -240 volts. The tube operates with a resonator grid potential of 1295 volts above the cathode, and with an average cathode current of 12 ma. For safety in handling, the resonator is grounded and the cathode operates at a negative potential. The USN-2K48 klystron incorporates the center conductor of a coaxial cavity, connected to the second resonator grid, as an integral part of its construction. The external connection to the first resonator grid is a thin, flexible copper disc. The external connection to the reflector is a cap at the top of the tube.

(c) Coaxial Cavity Resonator:

A general discussion of the theory of operation of coaxial cavity resonators is given in subparagraph 3e(2). In the TN-131B/APR-9 oscillator the length of the cavity is essentially 3/4 wavelength at the operating frequency, and the 3-3/4 repeller mode of the tube is utilized. In a simple cylindrical cavity, it would be possible, at certain tuning positions, for the tube also to oscillate at a frequency corresponding to a 1/4-wavelength cavity mode, with a 1-3/4-cycle reflector transit time. To prevent the occurrence of this second undesired oscillation, a mode suppressor is necessary. This mode suppressor is incorporated in the outer wall of the cavity as can be seen in Figure 2-22. The outer conductor is formed of two parts; a main cavity machined from cast aluminum and a mode suppressor head machined from brass. The annular slot between the mode suppressor head and the turned-down section of the outside of the main cavity body forms a short section

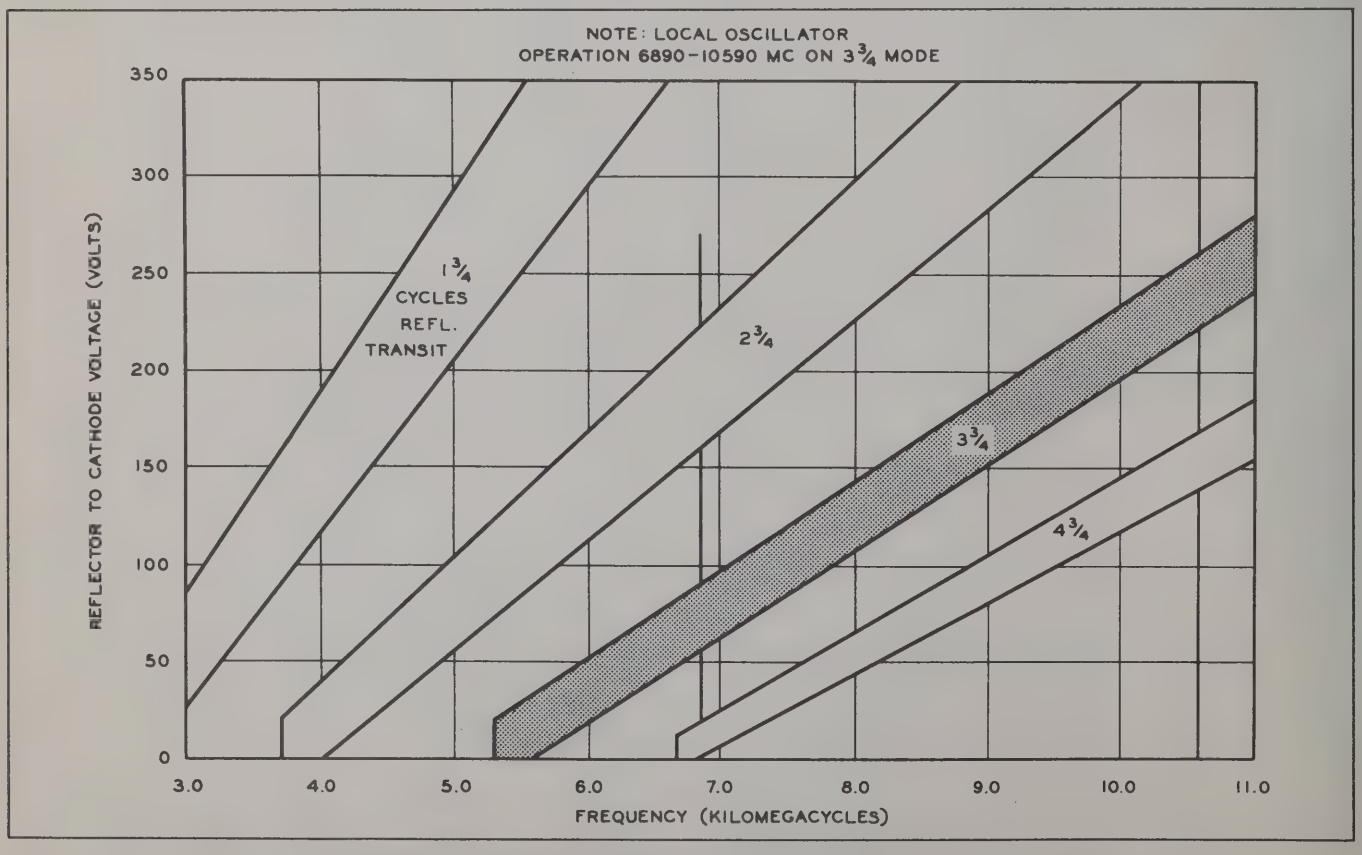


Figure 2-24, Reflector Transit Mode Characteristic of USN-2K48 Reflex Klystron

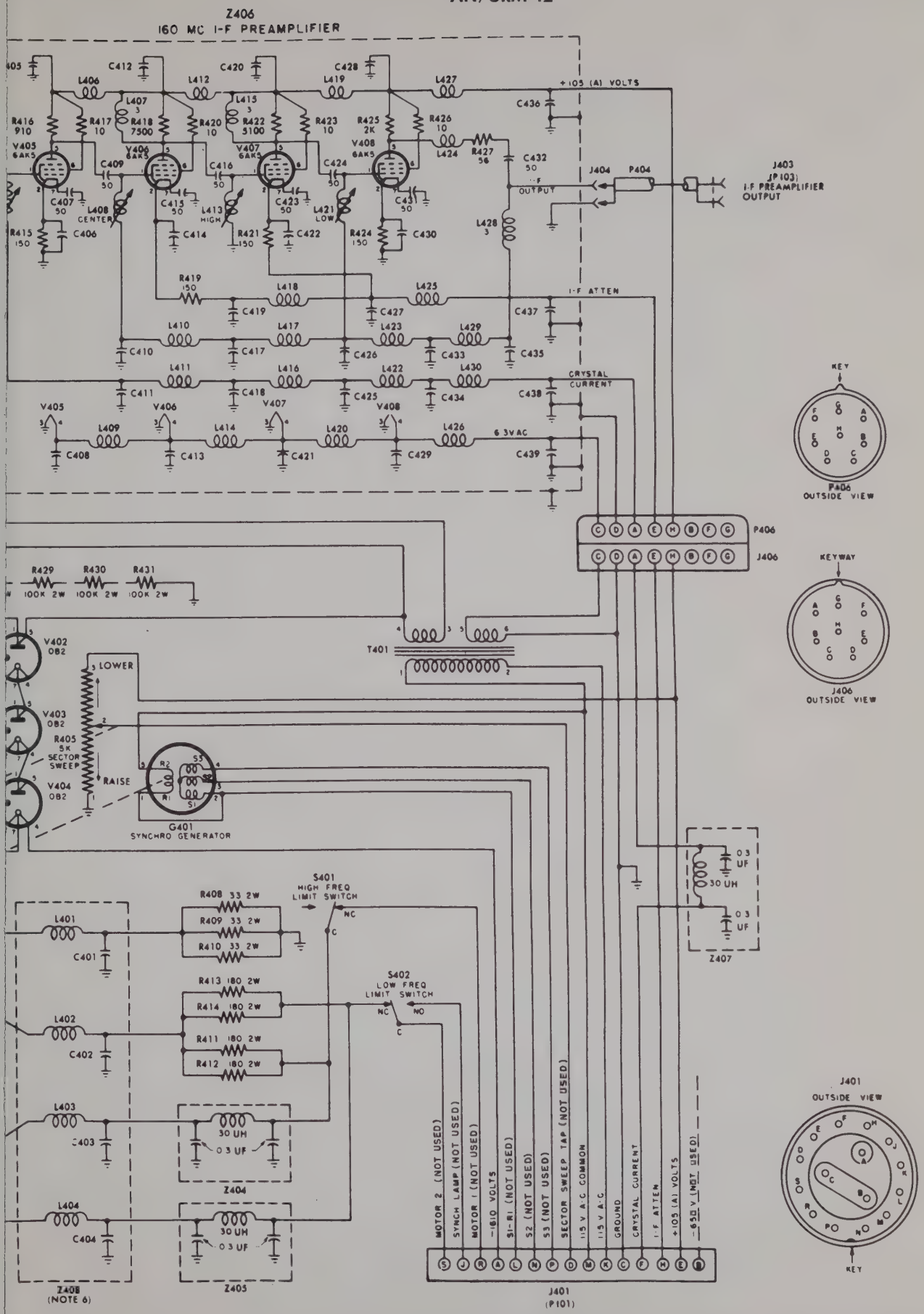


Figure 2-25, R-F Tuner TN-131B/APR-9, Schematic Diagram

built into the mixer, which is of such a size as to present a low impedance to the r-f signal and a high impedance to the i-f signal.

(4) Local Oscillator: (See Figure 2-23.)

(a) General:

The local oscillator of R-F Tuner TN-131B/APR-9 uses a USN-2K48 reflex klystron V401 designed specifically for use with an external coaxial cavity resonator. The oscillator tunes over the range from 6890 to 10,590 mc, always at 160 mc below the r-f signal frequency. The resonator is tuned by means of a noncontacting short-circuiting plunger. The reflector-to-cathode voltage of the tube is variable and tracks with the movement of the plunger through a mechanical drive system. Power is extracted from the resonator by loop coupling. The oscillator power is delivered to the mixer, where it is attentuated before it is applied to the crystal.

(b) Reflex Klystron:

Figure 2-24 shows the reflector transit mode characteristic of the USN-2K48 reflex klystron. The local oscillator operates throughout the frequency range on the 3-3/4-cycle reflector transit mode so that the reflector-to-cathode voltage varies from about -75 to -240 volts. The tube operates with a resonator grid potential of 1295 volts above the cathode, and with an average cathode current of 12 ma. For safety in handling, the resonator is grounded and the cathode operates at a negative potential. The USN-2K48 klystron incorporates the center conductor of a coaxial cavity, connected to the second resonator grid, as an integral part of its construction. The external connection to the first resonator grid is a thin, flexible copper disc. The external connection to the reflector is a cap at the top of the tube.

(c) Coaxial Cavity Resonator:

A general discussion of the theory of operation of coaxial cavity resonators is given in subparagraph 3e(2). In the TN-131B/APR-9 oscillator-the length of the cavity is essentially 3/4 wavelength at the operating frequency, and the 3-3/4 repeller mode of the tube is utilized. In a simple cylindrical cavity, it would be possible, at certain tuning positions, for the tube also to oscillate at a frequency corresponding to a 1/4-wavelength cavity mode, with a 1-3/4-cycle reflector transit time. To prevent the occurrence of this second undesired oscillation, a mode suppressor is necessary. This mode suppressor is incorporated in the outer wall of the cavity as can be seen in Figure 2-22. The outer conductor is formed of two parts; a main cavity machined from cast aluminum and a mode suppressor head machined from brass. The annular slot between the mode suppressor head and the turned-down section of the outside of the main cavity body forms a short section

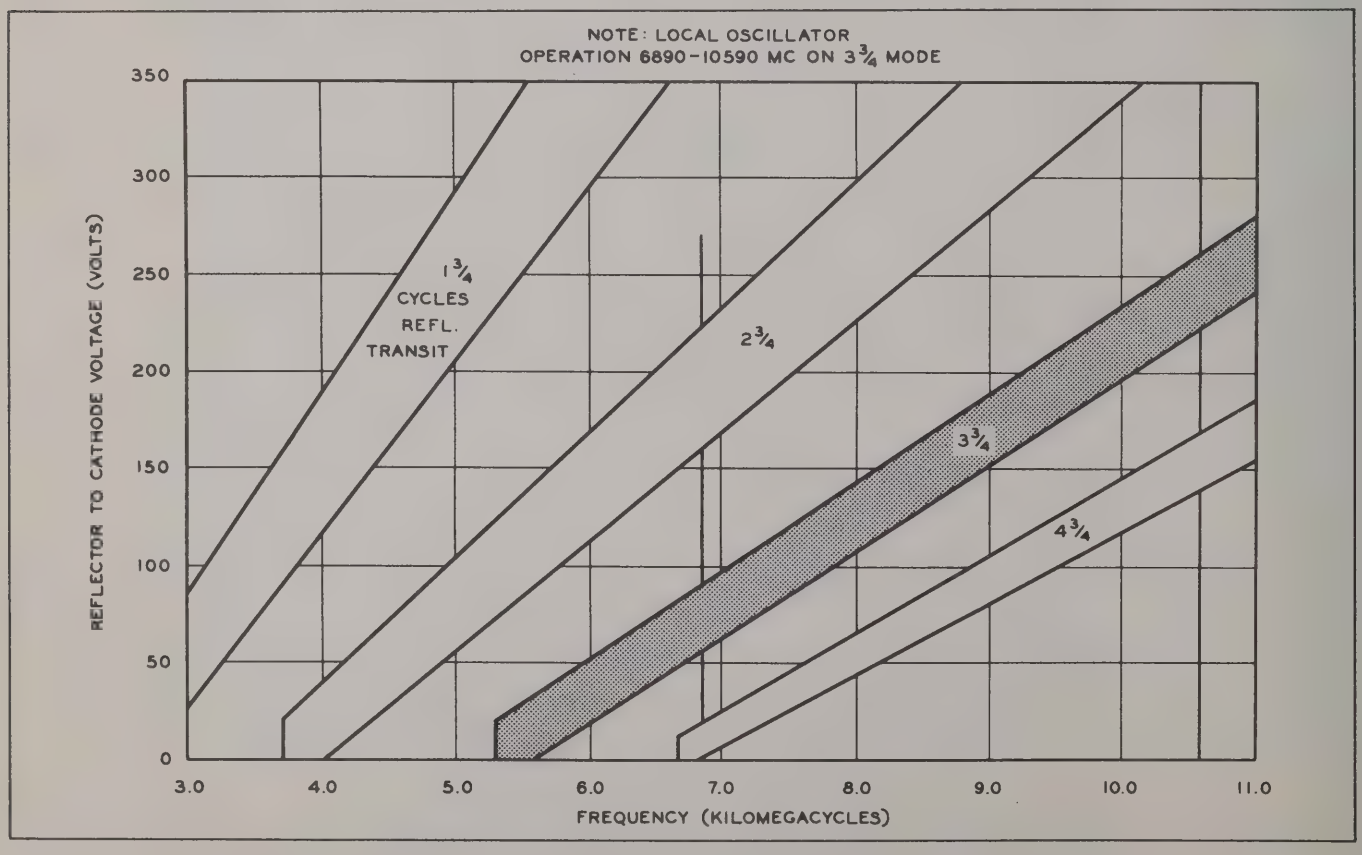


Figure 2-24, Reflector Transit Mode Characteristic of USN-2K48 Reflex Klystron

NOTES:

1. All resistor values are in ohms unless followed by "K" - kilohm (1,000 ohms). Tolerance is ±5% and power rating is ½ watt unless otherwise indicated.
2. All capacitor values are in micromicrofarads - "UUF", unless followed by "UF" - microfarad, and are 1,000 UUF unless otherwise indicated.
3. All fixed inductor values are in microhenries - "UH" and are approximately 0.25 UH unless otherwise indicated.
4. Limit switches S401 and S402 are normally closed as shown.
5. Crystal holder is part of I-F Preamplifier Z406.
6. Z408 not included beginning with serial no. 852 (approximately) and all subsequent units.
7. Values of C440 through C443 is 1500 UUF beginning with serial no. 852 (approximately) and all subsequent units.

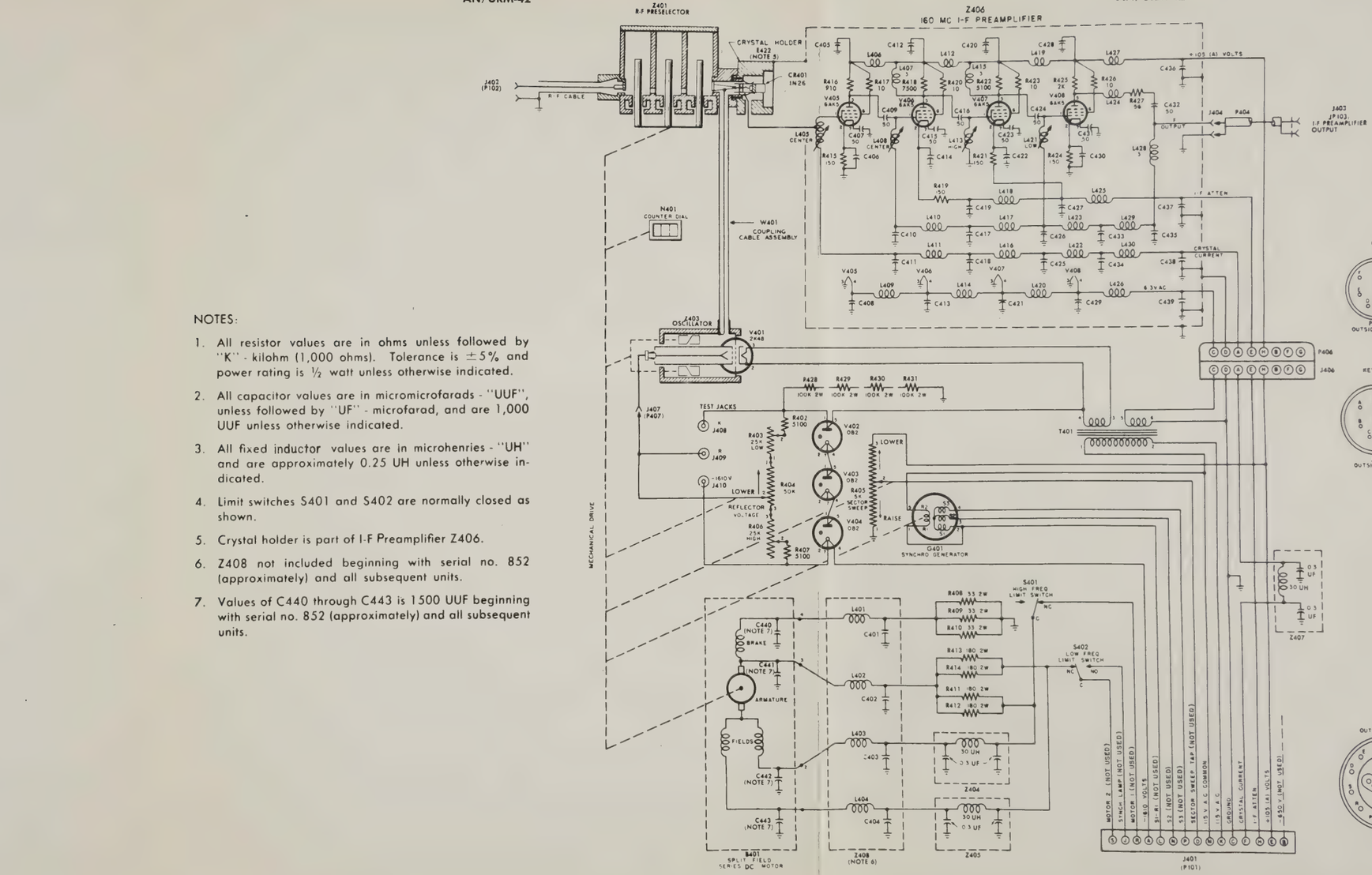


Figure 2-25, R-F Tuner TN-131B/APR-9, Schematic Diagram

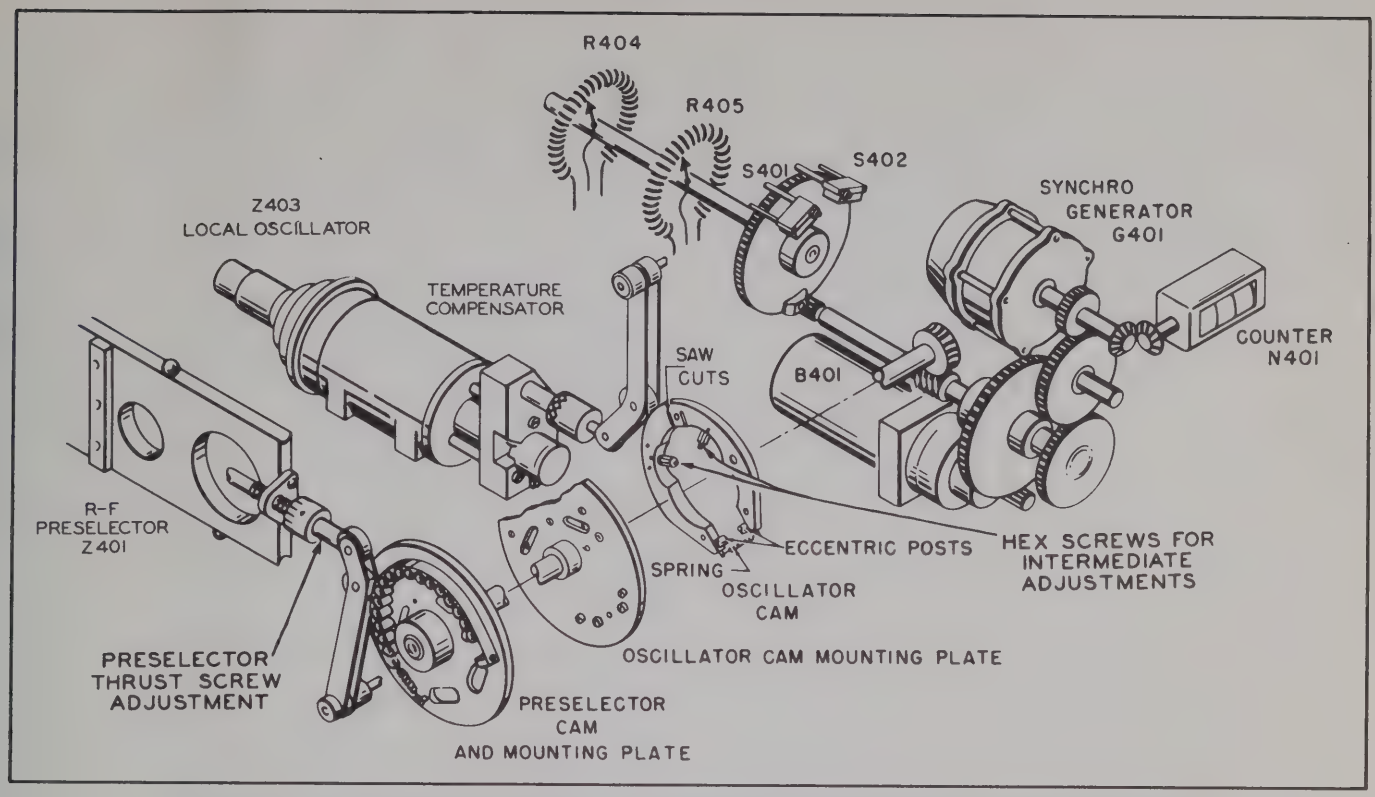


Figure 2-26, R-F Tuner TN-131B/APR-9, Mechanical Tuning Linkage, Schematic Diagram

of low-impedance coaxial line, which is effectively in series with the cavity outer conductor. The length of this series section of line and its position along the outer conductor is chosen so as to present an appreciable reactance to the interfering mode. Therefore, the resonant frequency of the cavity, for the interfering mode at cavity lengths where the two modes coincide, is changed with respect to the resonant frequency of the desired mode and the modes are separated by the reflector voltage selectivity. Because some additional reactance is presented to the desired mode by the suppressor, the cavity tuning characteristic is distorted somewhat from the ideal linear wavelength versus cavity length curve. Because higher-order circumferentially-propagated modes might be excited in the mode suppressor, a parasitic resonance could occur within the frequency range of the oscillator if no precautions were taken to avoid this trouble. Five slots, placed in the outer conductor of the mode suppressor and loaded with lossy dielectric slugs, serve to suppress all such parasitic resonances.

The local oscillator tube V401 is positioned in the cavity by means of a spring clamp which accurately aligns the axis of the center conductor portion of the tube with the axis of the outer conductor. This alignment is accomplished as the tube is inserted into the cavity. The center conductor portion of the tube meets with a spring-loaded ball which protrudes through the outer conductor into the rear section of the cavity. The spring pressure exerted against the tube by the ball forces it against four points of contact, which have been preset to insure accurate alignment. The longitudinal positioning of the tube is accomplished by the first resonator grid flange, which bears against a shoulder machined in the mode suppressor head. The flexible flange is then clamped securely against the shoulder by means of a hand-tightened ball bearing nut. The reflector cap of the tube mates with a spring-clip contact to which the reflector voltage is connected.

The oscillator is tuned by means of a non-contacting short-circuiting plunger. (See Figure 2-5.) In order to place circumferentially-propagated modes, which might be excited in the plunger gaps, outside the frequency range of the oscillator, the plunger contains five axial slots cut through its front section. The tuning plunger is supported by an assembly of two carriages connected together by three longitudinal rods. The forward carriage, on which the plunger is directly mounted, is supported by three ball bearing wheels, which roll on the cavity wall. Two of these bearings are fixed in position, though adjustable during manufacture for accurately centering the plunger in the cavity. The remaining bearing is spring-loaded radially outward. Similarly, the rear carriage is supported by three ball bearings, which ride on a central circular extension at the rear of the cavity.

Power is extracted from the cavity resonator by loop coupling at a fixed point in the cavity.

Further details will be found in sub-paragraph 3e(2).

(5) Mechanical Tuning System:

(a) General:

The mechanical tuning system of R-F Tuner TN-131B/APR-9 consists of suitable gears and cams ganging the tuning of the r-f preselector Z401, counter dial N401, local oscillator Z403, reflector voltage potentiometer R404, sector sweep potentiometer R405, synchro generator G401, and the tuning motor B401.

NOTE

TUNING MOTOR B401 IS DISENGAGED AT ALL TIMES DUE TO PLACEMENT OF A TUNING KNOB ON THE LOCAL TUNING CONTROL. SECTOR SWEEP POTENTIOMETER R405 AND SYNCHRO GENERATOR G401 ARE WITHOUT FUNCTIONS IN THE AN/URM-42 APPLICATION OF THE R-F TUNER.

Figure 2-25 is a schematic diagram of the TN-131B/APR-9 R-F tuner and illustrates the detailed elements of this system. Figure 2-26 is a schematic diagram of the gear system used to drive the tunable elements of the system, and shows the cam system used to convert the linear wavelength tuning of the local oscillator and preselector to a rotary linear frequency variation.

(b) Mechanical Linkage:

The mechanical linkage and gearing is shown in Figure 2-26. Drive motor B401 is disengaged by a clutch mechanism which is actuated by a pin extending from the tip of the local tuning control shaft. This pin is actuated at all times by the knob on the front panel end of the shaft. The main drive shaft is driven by the front panel knob. The front-panel end of drive shaft 0426 is geared to the synchro generator G401 and the counter N401. The rear end of the shaft is geared to the two potentiometers R404 and R405, through a large gear 0425, which also operates the limit switches S401 and S402. These switches are without functions in that the motor is disengaged from the drive shaft and does not have power applied to its windings. A worm thread on the main drive shaft turns the worm gear which actuates the preselector cam 0419 and the oscillator cam 0420.

(c) Oscillator and Preselector Cams:

In R-F Tuner TN-131B/APR-9 both the preselector and oscillator cams 0419 and 0420 are mounted on the same shaft, with the oscillator cam mounted directly behind the preselector cam. As the cams rotate, the oscillator tuning plunger and the preselector tuning carriage are actuated through pivoting lever arms 0416 and 0417. Each lever arm contains two rollers, one riding on the face of its respective cam and the other driving the respective tuning mechanism. Since the rotation of the main drive shaft is linearly proportional to frequency, the cams are shaped to transform the approximately linear-wavelength-versus-cavity-length tuning of the oscillator and preselector to a linear frequency tuning, while tracking them with each other and with the frequency indicating counter N401.

The contour of the local oscillator cam face may be adjusted by small amounts in order to accommodate all USN-2K48 tubes which require, within manufacturing tolerances, some variation in plunger position for a fixed oscillation frequency.

The low- and high-frequency eccentrics are provided for each extreme end of the frequency range. The intermediate low-frequency adjustment hexagonal screw and the intermediate high-frequency adjustment hexagonal screw are provided for fine adjustment within the frequency range. All adjustments are accessible through slots cut through the preselector cam mounting plate and are adjusted by either a screw driver or a 1/8-inch hexagonal wrench. Tuning the hexagonal screws clockwise will increase the oscillator frequency. An engraved dot on each eccentric adjusting shaft indicates the direction of maximum throw of the eccentric. The oscillator frequency is increased as the dot moves toward the rear of the unit. In effect, screwing the hex adjustment in, or turning the eccentric so that the dot moves toward the rear, pushes the cam out and shortens the cavity, thereby increasing the frequency. When the high-frequency eccentric or the intermediate high-frequency hexagonal screw is adjusted, the contour of the upper-frequency half of the cam face length is varied, and when the low-frequency eccentric or the intermediate low-frequency hexagonal screw is adjusted, the lower frequency half of the cam face length is varied, each adjustment being independent. Another independent adjustment of oscillator tracking is provided by means of a fine-pitch screw, which varies the effective length of the oscillator plunger rod. This adjustment is made at the center frequency of the tuning range. Independent locking screws are provided for all adjustments except for the intermediate adjustments. The intermediate adjustments are secured against accidental rotation by elastic nylon pins engaging the threads of the screws.

The contour of the preselector cam face consists of a flexible strip of metal stretched tightly over a series of 18 eccentric studs which are spaced equally around the periphery of the cam. Each stud may be rotated by inserting the special wrench (provided with each tuner) into a slot cut on one end of the stud. When a stud is rotated, the cam radius at that point is varied, as a result of the stud eccentricity. Hence, multipoint independent adjustment of the cam shape is available, providing accurate tracking of the preselector with the

NOTES:

1 — RESISTANCE VALUES IN OHMS UNLESS FOLLOWED WITH "K" KILOHMS (1,000 OHMS) OR "MEG" MEGOHMS (1,000,000 OHMS).

2 — CAPACITANCE VALUES IN MICRO-MICROFARADS UNLESS FOLLOWED WITH "MF" MICROFARADS.

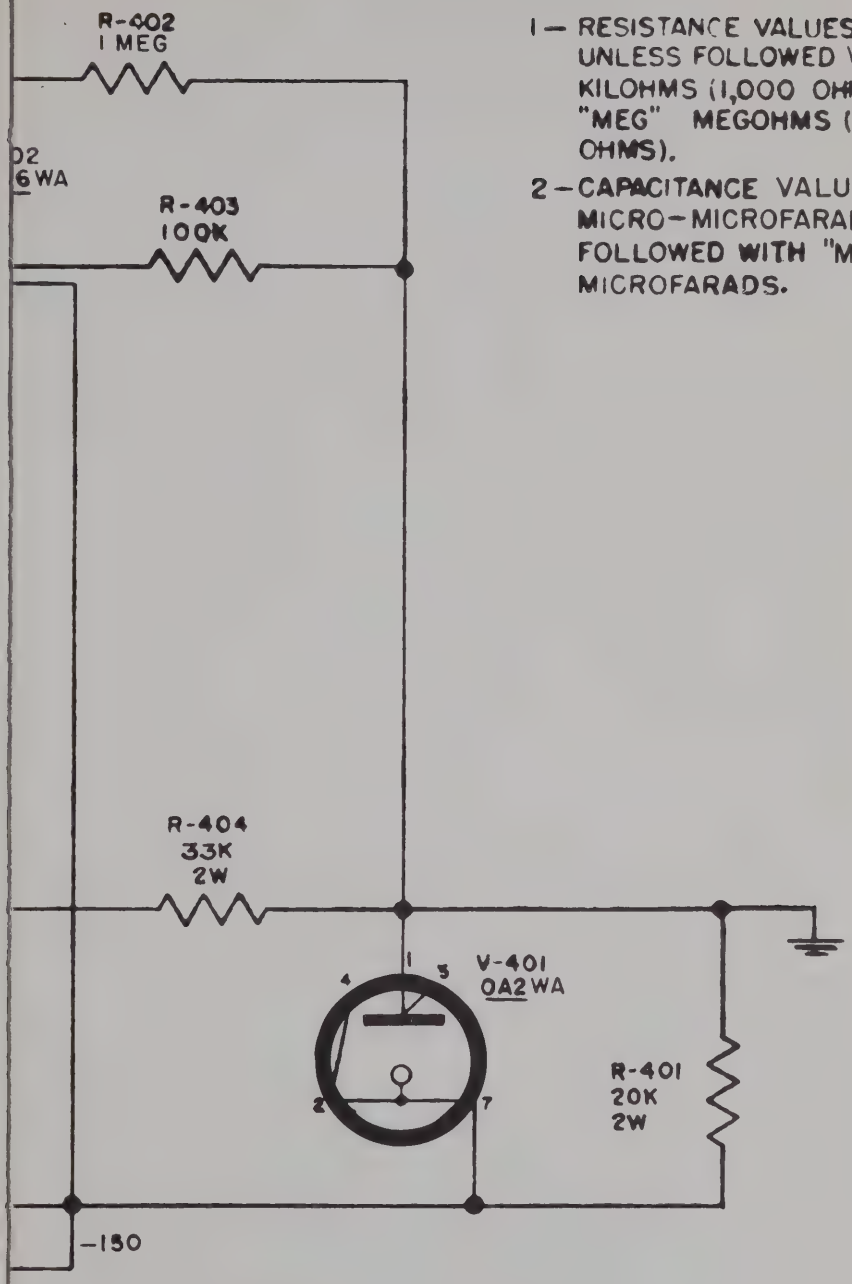
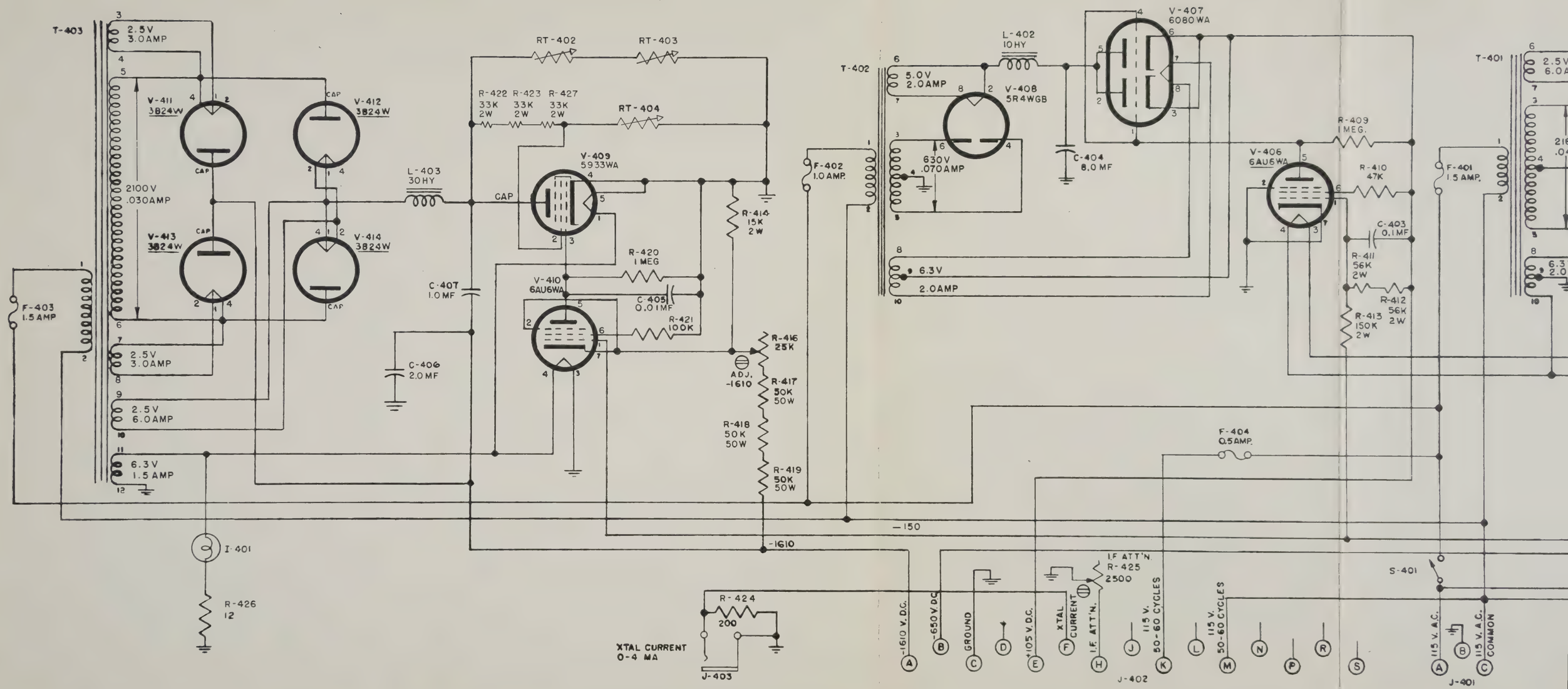


Figure 2-27, Power Supply PP-1179/URM-42, Schematic Diagram



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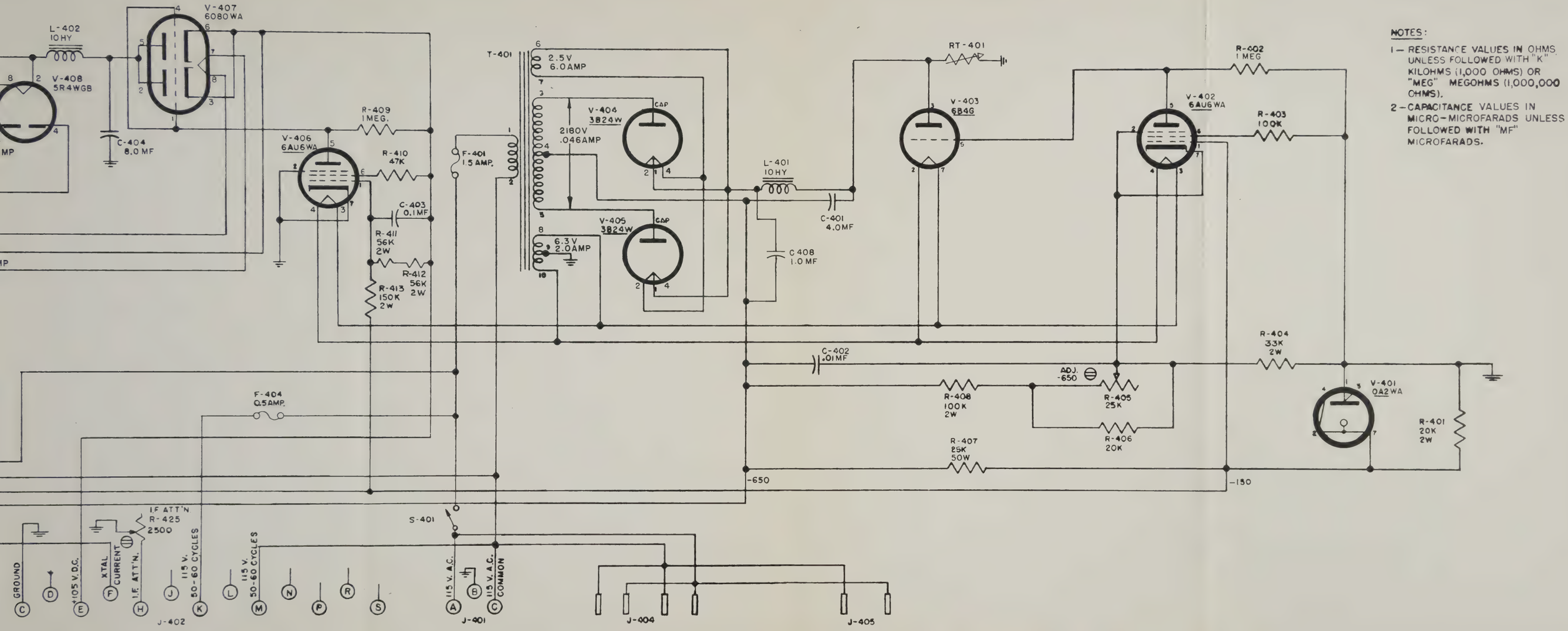

NOTES:

1 — RESISTANCE VALUES IN OHMS UNLESS FOLLOWED WITH "K" KILOHMS (1,000 OHMS) OR "MEG" MEGOHMS (1,000,000 OHMS).

2 — CAPACITANCE VALUES IN MICRO-MICROFARADS UNLESS FOLLOWED WITH "MF" MICROFARADS.

Figure 2-27, Power Supply PP-1179/URM-42, Schematic Diagram

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oscillator over the entire frequency range. In addition to the cam adjustments, a thumb-screw adjustment similar to that used on the local oscillator, is provided to facilitate alignment and testing of the preselector. All adjustments on the preselector cam are provided with central locking screws.

A temperature compensator is mounted on the local oscillator thrust screw. The change in length of the compensator with temperature causes the expansion or contraction of the thermal elements thereby maintaining the oscillator frequency in proper relationship to the preselector tuning frequency.

(6) I-F Preamplifier:

The theory of operation of the TN-131B/APR-9 i-f preamplifier is described in sub-paragraph 3g of this section.

(7) Reflector Voltage Network:

(See Figure 2-25.) A voltage of -1610 volts with respect to ground is provided for V401 in the local oscillator. A reflector voltage network is connected in series with the cathode-to-resonator grid circuit of the klystron, and the negative voltage is applied across this series circuit, the resonator grids being at ground potential. The reflector voltage network, consisting of the three voltage regulator tubes V402, V403, and V404, maintains a constant voltage across the network so that the voltage between the cathode and the grounded resonator grids of the klystron is held at -1295 volts. The resistance circuit of the reflector voltage network, consisting of R402, R403, R404, R406, and R407, provides the reflector-to-cathode voltage, which varies while the oscillator is being tuned. The moving arm of R404, connected through P407 and J407 to the reflector electrode of the klystron and tracked by the mechanical drive system, provides the correct voltage. R403 provides adjustment of the reflector voltage at the low-frequency end of the tuning range and R406 provides adjustment at the high-frequency end. Three test points J408, J409, and J410, are provided to check the voltages at the cathode and repeller electrodes of V401 and at the -1610-volt input.

(8) Filament Voltage Circuit:

Filament voltage is furnished by transformer T401 from two secondary windings, one of which furnishes 6.3 volts to the heater of V401, the other 6.3 volts to V405, V406, V407, and V408. Plate voltage for the i-f preamplifier is furnished through J401 from the R-F Tuner Power Supply.

4. POWER SUPPLY PP-1179/URM-42

a. General:

(See Figure 2-27.) Power Supply PP-1179/URM-42 functions to supply operating voltages to the R-F Tuner in use. These supply voltages are at -1610-volts, -650-volts, and +105 volts dc, and 115-volts ac. The unit utilizes three separate power supplies to accomplish this purpose. In addition, the unit mounts a POWER ON-OFF switch S401 which controls application of both a-c and d-c voltages to the R-F Tuner, and provides facilities for adjusting the gain of the R-F Tuner i-f preamplifier and monitoring the mixer crystal current. Potentiometer R425 is connected, through J402 and external cabling, into the cathode circuits of the second and third i-f amplifiers of the preamplifier. The total cathode current drawn by the two tubes passes through this potentiometer and, thus, the setting of R425 determines the bias and, therefore, the gain of the tubes. The crystal current jack J403, shunted by a 200-ohm resistor R423, functions as the d-c return for the input coil of the i-f preamplifier and the crystal mixer. A microammeter, plugged into J403, permits monitoring of the crystal current to aid in alignment procedures of the R-F Tuner.

b. —1610-Volt Circuit:

Primary a-c power of 115-volts ac is connected to the primary of high voltage transformer T403 through POWER ON-OFF switch S401 and fuse F403. In addition, a negative potential of -150 volts dc is connected to the circuit from the -650-volt circuit. This negative voltage is applied to the grid of control tube V410. The secondaries of transformer T403 provide high voltage at 2650 volts, and filament voltage at 2.5 volts, to the high vacuum rectifier tubes V411, V412, V413, and V414 and filament voltage of 6.3 volts to the control and series regulator tubes V410 and V409, respectively. The output of the full-wave bridge rectifier at -1610 volts dc is taken from the plate tie point of V411 and V413 and applied to the R-F Tuner through receptacle J402 by means of an external cable. The positive output is filtered by the choke-input filter, consisting of choke L403 and capacitor C406, and passes through the regulator tube V409 and to ground through the cathode of the regulating tube. Resistors R414 through R419 form a voltage divider from the -1610-volt terminal to ground and the cathode of control tube V410 is connected to the junction of resistor R415 and the movable contact of potentiometer R416. This bleeder holds the cathode of V410 at a potential adjustable from -155 to -140 volts with respect to ground. Since the grid of the control tube is maintained at a regulated potential of -150 volts, the bleeder provides a net bias of from -10 to +5 volts, depending on the position of potentiometer R416. The plate circuit of the control tube V410 is completed through the plate load resistor R420 to ground. The plate is directly coupled to the control grid of the series regulator tube V409. Screen voltage for the control tube is derived through the dropping

resistor R421 from ground. It should be noted that while the grid potential of control tube V410 is rigidly stabilized at -150 volts by the regulator tube (part of the -650-volt power supply), the cathode of V410 is free to vary with any change in the -1610-volt output from the rectifier, whether this variation results from fluctuations in the supply voltage or from an increased load. A variation at the cathode of the control tube V410, multiplied by the gain of V410, appears at the grid of the series regulator tube V409 with a polarity which introduces a compensating change in the plate resistance of the latter tube. For example, if the output voltage drops slightly, the voltage at the cathode of V410 becomes more positive because of the decreased current through the bleeder, and plate current through V410 is decreased. As a result, the plate potential of V410 and, hence, the grid potential of V409, becomes more positive resulting in a decrease in the series plate resistance of V409. A lesser portion of the rectifier output voltage is dropped across V409 and the output from the plate junction of tubes V411 and V413 returns to its predetermined value. A similar action with opposite effect occurs when the output from the circuit tends to rise. Potentiometer R416 provides a means for setting the output voltage to exactly -1610 volts. The regulated output is held within ±1.0% of its nominal value through use of this regulating circuit. Thyrite resistor RT404 stabilizes the screen voltage of V409. Thyrite resistors RT402 and RT403 reduce voltage surges that appear at the plate of V409 during starting periods.

c. −650-Volt Circuit:

The primary of power transformer T401 receives 115-volt a-c power whenever POWER switch S401 is in its ON position. Fuse F401 provides overload protection to T401. The secondaries of transformer T401 provide high voltage and filament power to the full-wave rectifier which consists of high-vacuum rectifier tubes V404 and V405, and 6.3 volts to the filaments of control tube V402, series regulator V403, and V406, the control tube of the -105-volt power supply circuit. The rectified negative potential is taken from terminal 4 of transformer T401 and applied to the R-F Tuner through J402 and external cabling. The positive output is filtered by the choke input filter, consisting of choke L401 and capacitor C4401, and passes through the series regulator tube V403 and to ground through the regulator tube filament winding center-tap (terminal 9) of transformer T401. Two voltage-divider networks are connected from the -650-volt bus to ground. One of these networks, consisting of resistors R401, R407, and cold-cathode voltage regulator tube V401, functions to supply a regulated -150-volt reference potential to the control grid of control tube V402. The second divider, consisting of resistors R404, R405, R406, and R408, functions to provide a negative potential to the cathode of V402 that is adjustable from -150 to -138 volts. A net bias is available, therefore, of from zero to -12 volts, depending on the position of potentiometer R405. The plate circuit of the tube is completed through load resistor R402 to ground. The plate is directly coupled to the control grid of series regulator tube V403. Voltage variations appearing across the control tube cathode voltage divider network cause proportional changes in the cathode voltage of V402. These variations, multiplied by the gain of V402, appear at the grid of V403 with a polarity which introduces a compensating change in the plate resistance of the latter tube, causing the output voltage to remain constant at its preset value. Operation of the circuit is very similar to that of the -1610-volt regulator circuit (refer to subparagraph 4c). Thyrite resistor RT401 is a voltage-sensitive resistor which reduces voltage surges that appear across tube V403 during starting periods.

d. +105-Volt Circuit:

The regulated +105-volt power supply utilizes a conventional full-wave rectifier V408 and a series regulating circuit to provide a stabilized output voltage within ±1.0% of its rated value. The rectifier output is filtered by a choke-input filter, consisting of choke L402 and capacitor C404, and applied directly to the plate of the regulator V407. Output of the circuit is taken from the cathode of V407. A voltage divider network, consisting of resistors R411, R412, and R413, is connected between the +105-volt output and the -150-volt bus and provides an approximate -4-volt potential to the grid of control tube V406. The cathode of V406 is retained at ground potential. Should the output voltage vary due to supply fluctuations or load changes, the voltage at the grid of V406 will vary proportionately, resulting in consequent changes in the voltage at the plate of V406. This plate is directly coupled to the grids of regulator V407 and the changes in the plate voltage of V406 cause resultant changes in the effective plate resistance of regulator V407. These regulator plate resistance variations compensate for the unbalance and return the output to its nominal, preset, value. The center tap of the regulator filament winding of transformer T402 is returned to the +105-volt output to prevent the large difference in cathode-to-filament potential which would otherwise exist.

5. METER, RADIO FREQUENCY INTERFERENCE IM-103/URM-42

a. General:

The Meter, Radio Frequency Interference IM-103/URM-42, hereinafter referred to as RI-FI Meter, consists essentially of the i-f, detector,

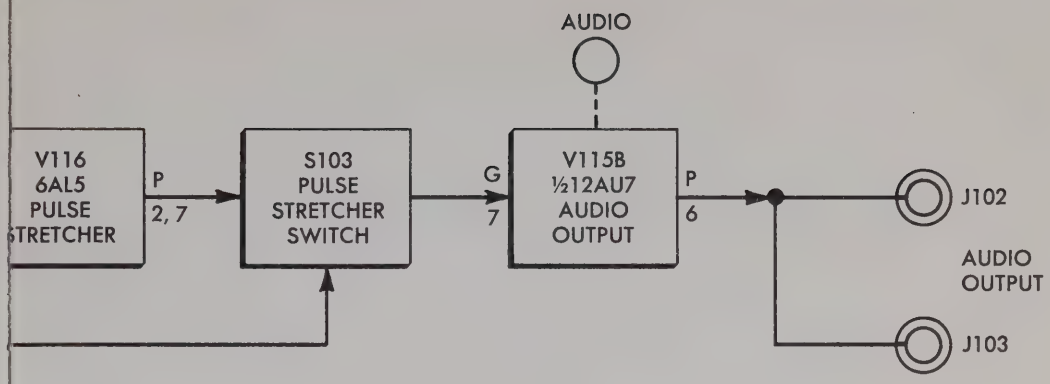

Figure 2-28, Meter, Radio Interference IM-103/URM-42, Block Diagram

resistor R421 from ground. It should be noted that while the grid potential of control tube V410 is rigidly stabilized at -150 volts by the regulator tube (part of the -650-volt power supply), the cathode of V410 is free to vary with any change in the -1610-volt output from the rectifier, whether this variation results from fluctuations in the supply voltage or from an increased load. A variation at the cathode of the control tube V410, multiplied by the gain of V410, appears at the grid of the series regulator tube V409 with a polarity which introduces a compensating change in the plate resistance of the latter tube. For example, if the output voltage drops slightly, the voltage at the cathode of V410 becomes more positive because of the decreased current through the bleeder, and plate current through V410 is decreased. As a result, the plate potential of V410 and, hence, the grid potential of V409, becomes more positive resulting in a decrease in the series plate resistance of V409. A lesser portion of the rectifier output voltage is dropped across V409 and the output from the plate junction of tubes V411 and V413 returns to its predetermined value. A similar action with opposite effect occurs when the output from the circuit tends to rise. Potentiometer R416 provides a means for setting the output voltage to exactly -1610 volts. The regulated output is held within ±1.0% of its nominal value through use of this regulating circuit. Thyrite resistor RT404 stabilizes the screen voltage of V409. Thyrite resistors RT402 and RT403 reduce voltage surges that appear at the plate of V409 during starting periods.

c. −650-Volt Circuit:

The primary of power transformer T401 receives 115-volt a-c power whenever POWER switch S401 is in its ON position. Fuse F401 provides overload protection to T401. The secondaries of transformer T401 provide high voltage and filament power to the full-wave rectifier which consists of high-vacuum rectifier tubes V404 and V405, and 6.3 volts to the filaments of control tube V402, series regulator V403, and V406, the control tube of the -105-volt power supply circuit. The rectified negative potential is taken from terminal 4 of transformer T401 and applied to the R-F Tuner through J402 and external cabling. The positive output is filtered by the choke input filter, consisting of choke L401 and capacitor C4401, and passes through the series regulator tube V403 and to ground through the regulator tube filament winding center-tap (terminal 9) of transformer T401. Two voltage-divider networks are connected from the -650-volt bus to ground. One of these networks, consisting of resistors R401, R407, and cold-cathode voltage regulator tube V401, functions to supply a regulated -150-volt reference potential to the control grid of control tube V402. The second divider, consisting of resistors R404, R405, R406, and R408, functions to provide a negative potential to the cathode of V402 that is adjustable from -150 to -138 volts. A net bias is available, therefore, of from zero to -12 volts, depending on the position of potentiometer R405. The plate circuit of the tube is completed through load resistor R402 to ground. The plate is directly coupled to the control grid of series regulator tube V403. Voltage variations appearing across the control tube cathode voltage divider network cause proportional changes in the cathode voltage of V402. These variations, multiplied by the gain of V402, appear at the grid of V403 with a polarity which introduces a compensating change in the plate resistance of the latter tube, causing the output voltage to remain constant at its preset value. Operation of the circuit is very similar to that of the -1610-volt regulator circuit (refer to subparagraph 4c). Thyrite resistor RT401 is a voltage-sensitive resistor which reduces voltage surges that appear across tube V403 during starting periods.

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5. METER, RADIO FREQUENCY INTERFERENCE IM-103/URM-42

a. General:

The Meter, Radio Frequency Interference IM-103/URM-42, hereinafter referred to as RI-FI Meter, consists essentially of the i-f, detector,

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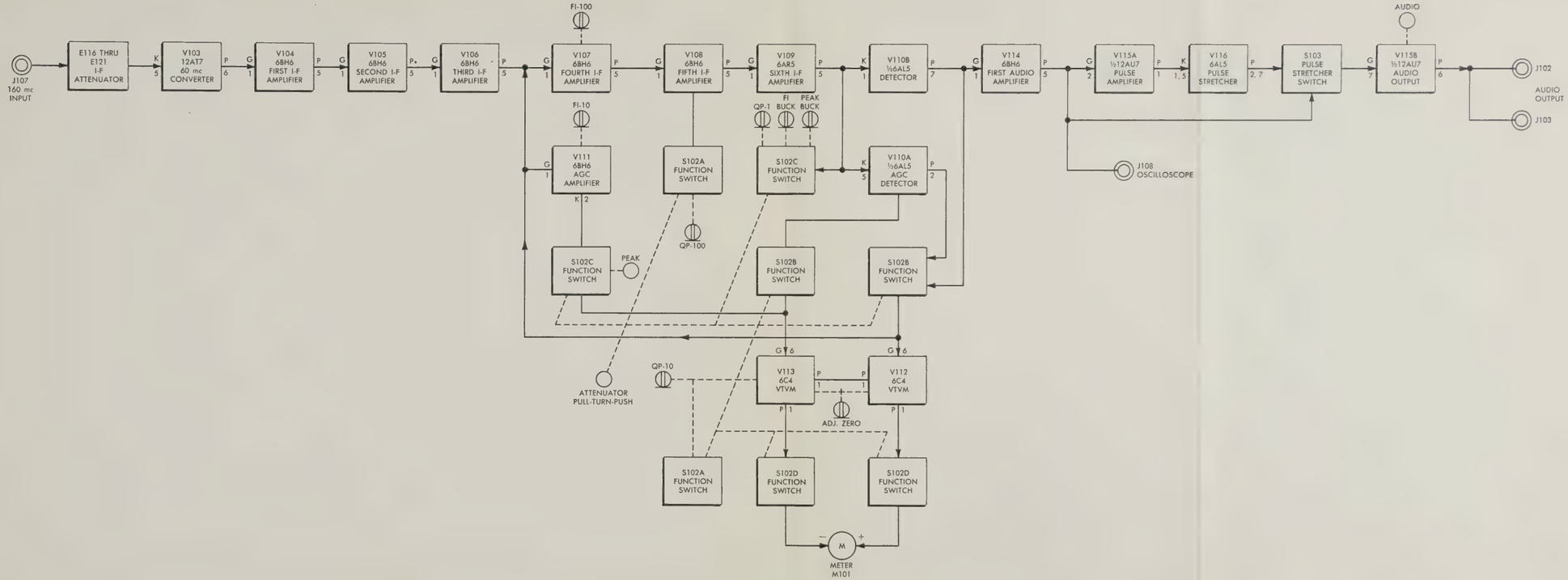

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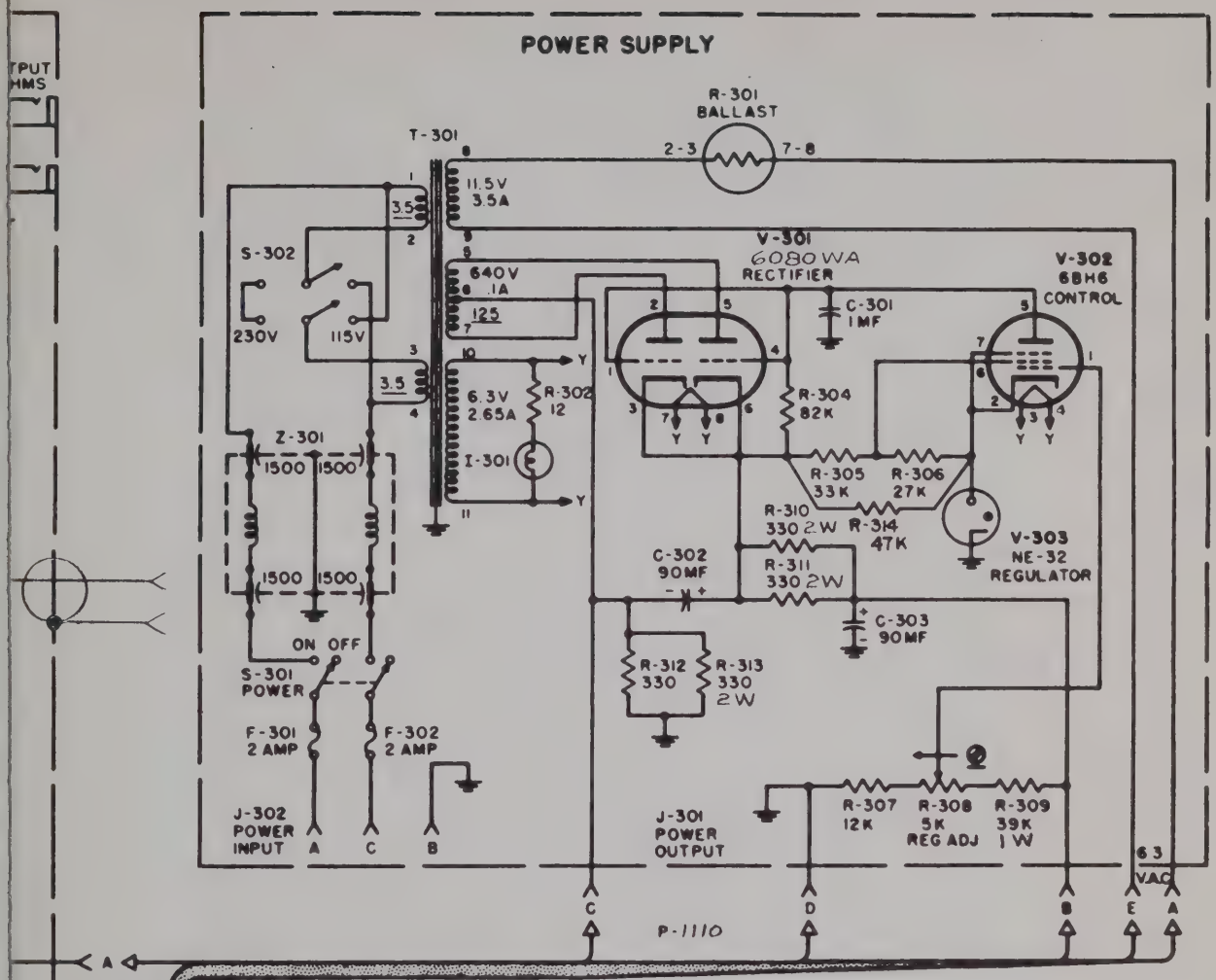
Figure 2-28, Meter, Radio Interference IM-103/URM-42, Block Diagram



NOTES:

1. Resistance values in ohms, unless followed with "K" - kilohms (1,000 ohms) or "MEG" - megohms (1,000,000 ohms).
2. Capacitance values in micro-microfarads, unless followed with "MF" - microfarads.
3. Inductance values in microhenries, unless followed with "MH" - millihenries (1,000 microhenries).
4. FUNCTION switch shown in F1 position; PULSE STRETCHER switch in OFF position. Switch sections shown as viewed from front of panel.
5. Resistance of transformer windings and coils shown underlined (00). No resistance value shown when resistance is less than one ohm.
6. RESISTORS ARE 1/2 WATT UNLESS OTHERWISE NOTED.

Figure 2-29, Meter, Radio Interference IM-103/URM-42, Schematic Diagram

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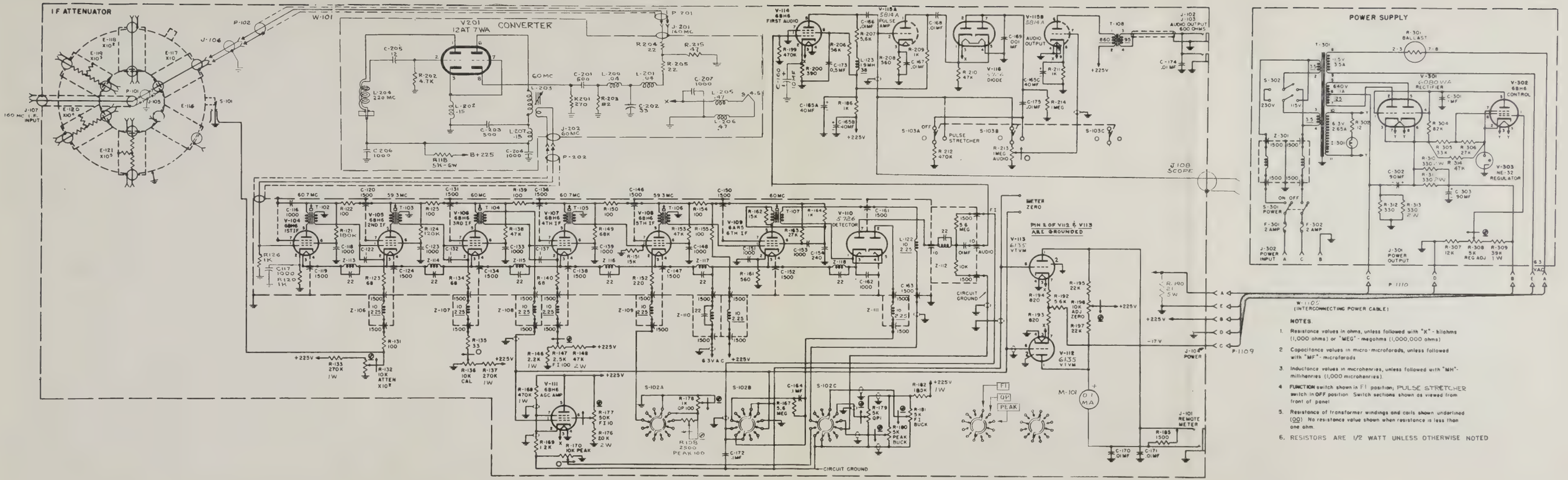
RADIO INTERFERENCE AND FIELD INTENSITY METER



NOTES.

1. Resistance values in ohms, unless followed with "K" - kilohms (1,000 ohms) or "MEG" - megohms (1,000,000 ohms)
2. Capacitance values in micro-microfarads, unless followed with "MF" - microfarads
3. Inductance values in microhenries, unless followed with "MH" - millihenries (1,000 microhenries).
4. FUNCTION switch shown in FI position; PULSE STRETCHER switch in OFF position. Switch sections shown as viewed from front of panel.
5. Resistance of transformer windings and coils shown underlined (00). No resistance value shown when resistance is less than one ohm.
6. RESISTORS ARE 1/2 WATT UNLESS OTHERWISE NOTED

Figure 2-29, Meter, Radio Interference IM-103/URM-42, Schematic Diagram

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and audio portions of a conventional superhetrodyne receiver, together with a calibrated attenuator, vacuum-tube voltmeter, weighting circuit, and facilities for making low-repetition-rate pulses audible at the audio output. The block diagram, Figure 2-28, illustrates the main interconnections between the various tubes and circuits. The 160-mc input from the R-F Tuner passes through a step attenuator and is mixed with the output of the local oscillator to produce a second, 60-mc, i-f frequency. This i-f voltage is amplified in six i-f amplifier stages and is demodulated in a detector stage. The demodulated signal is modified by the weighting circuits and applied to a balanced VTVM stage which, in turn, serves to actuate a direct-reading meter. The audio components of the detector output are amplified, and, in the case of low-PRF signals, modified, and are delivered to the headphone jacks.

Measurements can be made with the RI-FI Meter in terms of the peak value of the signal or interference, the PEAK function, in terms of a weighted value, the QP (or quasi-peak) function, or in terms of the average value, the FI (or field intensity) function. The CAL (calibrate) position of the FUNCTION switch permits the gain of the meter to be set to a standard value utilizing the output of Generator, Interference SG-112/URM as an r-f input. This arrangement permits direct-reading indications of signal strength to be read on the meter face when the function switch is switched to the desired function and the R-F Tuner input is returned to the antenna.

The indicating meter scale is directly calibrated for a two-decade, approximately logarithmic range of 1-100 microvolts (top scale) and an approximately linear 0-40-db range (bottom scale). Since the inherent sensitivity of the RI-FI Meter is 10 microvolts, rather than one microvolt as implied by the meter markings, a 10-to-1 correction factor is required. This has been automatically provided by raising the attenuation marking of each attenuator step 20 db above its actual value. A schematic diagram of the RI-FI Meter unit (IM-103/URM-42) is shown in Figure 2-29.

b. I-F Attenuator:

The i-f attenuator is a six-position coaxial switch to which are connected six turret-mounted coaxial tubes E116 through E121. These tubes are mounted about a center shaft which imparts rotational motion to the assembly. Selection of an attenuator position requires a PULL-TURN-PUSH sequence; smooth, positive positioning is accomplished by a spring-loaded detent.

One position of the attenuator is unlabelled and functions to remove the input signal from the RI-FI Meter, terminating the signal across a 50-ohm resistive element. The X10 and $X10^2$ tubes are straight feed-through sections, providing zero attenuation; however, switch S101 is actuated by pins on the turret assembly when the attenuator is in the unlabelled and X10 positions. This switch functions to remove a 20-db attenuating bias from the second i-f stage when actuated. Thus, in the X10 position, maximum gain is realized through the i-f portions of the RI-FI Meter. In the $X10^2$ position, this bias is returned to the second i-f stage through the opening of switch S101. The $X10^3$, $X10^4$, and $X10^5$ positions of the attenuator channel the input signal through tubes which contain T-section resistive elements. These T-sections are designed to provide progressive steps of 20-db attenuation to the i-f input. The resistive element seals in the $X10^3$, $X10^4$, and $X10^5$ coaxial tubes are one-watt resistors formed by the application of thin metallic films on ceramic tubes or discs.

c. 60-mc Converter

The 60-mc converter V201 is a dual triode which operates as a local osillator and mixer. One half of the tube generates oscillations at a fixed frequency of 220 mc. These oscillations are taken from the cathode and applied to the grid of the second, or mixer, half of the tube while the 160-mc i-f input signals from the i-f attenuator are applied to the cathode of the mixer. The mixer functions to combine these signals and extract the resultant 60-mc i-f hetrodyne signal for application to the i-f strip of the RI-FI Meter.

The oscillator utilizes the equivalent of a 19-inch wire, bent double, as its tank circuit. However, due to the limitations on size, this "loop" has been wound as a bifilar coil on a doubly-threaded coil form. The 220 mc local oscillator output is taken from the cathode of the oscillator and directly coupled to the grid of the mixer half of the tube. The 160-mc i-f input to the mixer is connected through (a) an 8 db isolation pad consisting of R204, R205 and R215 that provides a 50-ohm termination for the IF Attenuator, through (b) a low-pass filter consisting of L200, L201 and C202 which suppresses fundamental and harmonics from the converter oscillator, and through (c) a coupling capacitor C201 and to the cathode of the mixer tube. The hetrodyne signal at the plate is at 60-mc and coupled through i-f transformer L203 to J202.

d. First and Second I-F Amplifier Stages:

The i-f strip is stagger-tuned about the 60-megacycle i-f frequency. Permeability-tuned transformer coupling is used between all stages. The plate voltage and heater voltage supplies to each i-f stage are filtered to reduce the common impedance between stages, thus, preventing feedback. In order to afford attenuation, gain and AGC features in the i-f strip, several of the i-f stages are operated at dissimilar levels of operating bias. Compensation is required for the resulting Miller Effect which might otherwise result in a

degree of detuning due to variation, with signal strength, of the capacitance across the tuned grid circuit, In the method employed here, an unbypassed cathode resistor, in combination with a capacitance from grid to cathode, introduces feedback between the cathode and grid circuits which, in effect, reduces the capacitance between grid and ground with increasing transconductance, thereby, tending to compensate for the undesired detuning.

The first i-f stage utilizes a conventional amplifier using a 6BH6 pentode. The 60-mc input to the first i-f stage is obtained from the secondary of L203. Automatic bias is obtained from the cathode bias resistor R120 bypassed by capacitor C117. A dropping resistor R121 and bypass capacitor C118 are used in the screen circuit.

The second i-f stage is identical to the first stage except for the provisions for one step of attenuation. The received signal is not attenuated at the second i-f stage when the attenuator knob is in the unlabelled and X10 positions. In this case, the cathode of tube V105 is connected through cathode bias resistors R123 and R131 and the i-f filter Z106 to ground. In all other positions of the attenuator knob, switch S101 is opened, and the cathode circuit of V105 is connected to a voltage divider consisting of resistors R133 and R132 for the application of an adjustable fixed bias to the stage and a resultant 20-db drop in gain. Miller Effect compensation required due to changes in tube operating bias is accomplished by leaving cathode resistors R123 and R131 unbypassed and by paralleling the grid-to-cathode tube capacitance with capacitor C122.

e. Third and Fourth I-F Amplifier Stages:

The third i-f stage differs from the preceding stages by the addition of a manual gain control labeled CAL. This control, potentiometer R136, selects a fixed cathode bias voltage for tube V106. In this fashion, the gain of the RI-FI Meter is adjusted, in conjunction with a calibrating voltage from the Impulse Noise Generator, to obtain a standard meter reading of 100 when the input is 100 units. As in previous stages, Miller Effect compensation is accomplished by the connection of capacitor C132 across the grid-to-cathode tube capacitance, and by neglecting to bypass the cathode resistors, Heater, bias, and plate supply voltages to the stage are filtered to prevent feedback.

The fourth i-f stage is the AGC-controlled stage with AGC voltage applied to the control grid of tube V107 for automatic gain control of the i-f strip. The inclusion of capacitor C137 and failure to bypass the cathode resistor R140 compensates for the Miller Effect resulting from the changes in tube operating bias by application of the AGC voltage. Cathode bias for this stage is adjusted by potentiometer R147 to obtain meter scale tracking at the top of the range in the FI function. Resistor R151 is shunted across the secondary of transformer T105 in order to load the coil and broaden the bandwidth at this stage.

The AGC voltage derived from the detector load resistor is negative with respect to a point called circuit ground. Circuit ground is the return circuit from diode load to diode cathode. The indicating meter scale is approximately logarithmic, and the AGC amplifier V111 is used to compress the upper half of the meter scale by modifying the AGC voltage at the grid of the fourth i-f stage V107. V111 is connected in a voltage divider from B+ to ground. The screen grid potential is adjusted by potentiometer R177 so that V111 begins to cut off when an AGC voltage equivalent to one-half scale appears at the control grid of tubes V111 and V107. Since circuit ground is connected to the high side of potentiometer R170 in the cathode circuit of tube V111, this move toward cutoff of V111 decreases the voltage drop across potentiometer R170. Since the AGC voltage is negative, the decrease in voltage across potentiometer R170, in effect, adds to the AGC voltage with respect to the fixed bias on tube V107. This composite voltage overcomes the fixed bias on tube V107 and reduces the gain of the stage.

f. Fifth and Sixth I-F Amplifier Stages:

The fifth i-f stage is provided with adjustable fixed gain with its bias varied in certain function switch positions to equalize the gain for all functions. Miller Effect compensation is accomplished by leaving resistor R152 unbypassed. The cathode potential of tube V108 is adjusted by potentiometer R178 to obtain meter scale tracking at the top of the scale in the QP function. For the same reason, the potentiometer R198 (marked QP-10, but the function is actually PEAK-100) is connected in series with R178 in the PEAK position of the function switch.

The sixth i-f stage is a power driver stage using a power amplifier pentode 6AR5 in a fixed high-gain circuit with a high dynamic range (overload capacity). Cathode bias is used. Screen grid neutralization is obtained by a voltage tapped off a voltage divider consisting of transformer T107 and capacitor C154 and coupled to the screen. The sixth i-f stage output is developed across the transformer T107, which presents a low impedance source to the detector in order to obtain short detector charging time. Resistor R162, in shunt across the primary of transformer T107, broadens the bandwidth of the stage.

g. Detector Stage:

The 6AL5 diode detector V110 demodulates the i-f signal in a linear duo-diode detector circuit. One diode output branches into two circuits: to the

first audio stage V114 and to the AGC and VTVM circuits in FI and PEAK functions. The other diode furnishes an output to the AGC and VTVM circuits in the CAL and QP functions. That portion of the demodulated signal passing to the VTVM circuits will be known as the "d-c" voltage, while that portion passing to the audio circuits will be known as the audio signal. It should be noted, however, that both portions of the diode output originally contain both audio and d-c components (corresponding to carrier intensity) if both were present in the received signal. The naming of "d-c" voltage and audio signal is only for convenient reference purposes.

One important distinction constitutes a major difference in the audio and "d-c" output of the detector. The audio signal drops its d-c component (corresponding to carrier intensity) at the coupling capacitor in filter Z112, while the "d-c" voltage retains its d-c and a-f components.

h. Audio Amplifier Stages:

The first audio amplifier V114 is similar to a video amplifier with flat response to approximately one-half megacycle, partially due to the peaking circuit formed by resistor R207 and inductor L123. An oscilloscope receptacle J108 is connected into the plate circuit through coupling capacitor C166 to permit visual observation of the signals present.

Considering this section as a straight audio amplifier, the output of tube V114 is capacitively coupled to tube V115B through the OFF position of PULSE STRETCHER switch S103 and audio control potentiometer R213. Audio output tube V115B is operated as a voltage amplifier using automatic self bias. Audio amplifier output is taken from transformer T108 to the panel-mounted headphone jacks J102 and J103. The output level is adjusted by means of AUDIO potentiometer R213 in the input circuit of V115B.

In some instances, the received signal is a series of pulses so short and with a repetition rate so low that the power output of the audio amplifier is not sufficient to operate the headphones. The PULSE STRETCHER position of switch S103 is used to overcome this difficulty. A triode amplifier V115A and diode V116 are inserted between the first audio and audio output stages. The capacitor-resistor decay network in the diode load circuit widens the pulse signal for application to the audio power stage.

i. Vacuum-tube Voltmeter Stage:

The triode 6C4 tubes employed in the VTVM stage are connected in a circuit that is an adaptation of the familiar balanced VTVM circuit. The "d-c" voltage to be measured is applied to the grid of tube V112 and upsets the balance of the stage, causing the indicating meter M101 to deflect upscale, and indicating the magnitude of the unbalance.

The use of this balanced VTVM circuit counteracts the effects of supply voltage variations, since supply variations affect both tubes equally and the resulting changes in meter indication from this cause are negligible.

The ADJ ZERO control R196 balances the voltage applied to the plates of tubes V112 and V113. Balance is indicated by a zero reading of meter M101 when no signal input is present. Potentiometer R198, in series with meter M101, is a sensitivity control for adjusting the meter scale tracking at one-half scale in the QP and PEAK functions.

R-F pickup by the cables connected to the closed circuit REMOTE METER J101 is bypassed to ground by capacitors C170 and C171.

j. Weighting Circuits:

(1) General

NOTE

THE TERM "WEIGHTING" AS APPLIED TO THE AN/URM-42 EQUIPMENT SPECIFICALLY REFERS TO THE TIME CONSTANT INTRODUCED IN THE DETECTOR AND AGC CIRCUITS. THIS "WEIGHTING" EFFECTIVELY DETERMINES THE TIME-VERSUS-VOLTAGE CHARACTERISTICS OF THE INDICATION OBTAINED.

The weighting circuits are selected by the function switch S102 and serve to properly weight the signal supplied to the indicating meter for the three types of measurements performed by the equipment.

Simplified schematics from which all switching details have been deleted are used to illustrate these circuits.

(2) The Field Intensity Circuit:

The AGC and VTVM circuits see a voltage source which charges slowly and discharges slowly so that the meter indication shows an average of the input signal over 600 milliseconds continuously. The 10,000-ohm resistor in Z112 is the diode load resistor and a charge-discharge action is accomplished through the 5.6-megohm resistor in Z112 and by C172 in shunt with it and the load resistor.

The meter reading for field intensity is proportional to the field intensity of radiated signals, or proportional to the averaged value of r-f interference. The reading will be independent of modulation in the case of modulated CW signals because the time constant formed by the 10-micromicrofarad capacitor and 10,000-ohm resistor in Z112 is short enough to follow any modulation present at the detector input.

A voltage picked off resistor R181 applies a bias to tube V110 which counteracts the contact potential of the diode. This adjustment is made so that the initial meter adjustment (ADJ ZERO potentiometer R196) will hold for all positions of the function switch.

The network comprising capacitors C161 and

C163 and inductor L122 is an i-f filter designed to reject the 60-megacycle i-f voltage.

(3) The Quasi-Peak Circuit:

In the quasi-peak function, the time constants of the detector weighting circuits are approximately one millisecond charge and 600 milliseconds discharge. For pulse signals several microseconds or more in width and with a pulse repetition frequency (PRF) of 1000 per second or greater, the meter indication is near the peak value of an interfering signal as seen at the output of the second detector. For pulses sharp with respect to the reciprocal of the bandwidth (one microsecond) measurements can be made of a signal with a PRF as low as 120 pulses per second. At this PRF, the ratio of PEAK to QP readings is approximately 10-to-1 and so a full-scale QP reading represents a pulse amplitude at the output of the second detector which is in the dynamic range limit (20-db) of the equipment. The diode load resistor is R167 and the weighting circuit charge-discharge action is accomplished by capacitor C164 across the diode load. I-F Filter Z111 rejects the 60-mc i-f voltage.

QP 1 potentiometer R179 functions in the same manner as did potentiometer R181 described in paragraph 5j(2). A separate potentiometer is employed because the actual bucking potential is different than that required in the field intensity position of the function switch due to the different diode loads. Quasi-peak meter indications are adjusted to be the same as those in the field intensity function, using the same unmodulated signal, by adjustment of the QP 100 potentiometer R178.

(4) The Peak Circuit:

In the peak function, the circuit is similar in some respects to the field intensity circuit described in subparagraph 5j(2). The VTVM and AGC circuits are the same, but an additional bias circuit R170 has been added to enable the measurement of peak signal values. The peak value measured is the peak as seen by the second detector and not the true peak of the signal at the antenna input. The PEAK function of the function switch acts to apply a d-c voltage in parallel with the signal input. The circuit is similar to an adjustable delayed AGC system, since the d-c voltage is also applied to the detector V110. The d-c voltage is manually adjusted to the threshold of diode rectification. This measurement technique is similar to that employed in the "slide-back" voltmeter. For any given measurement at the low end of the meter scale, the PEAK BUCK control R180 equalizes the meter reading obtained in the peak position of the function switch with that obtained in the field intensity position.

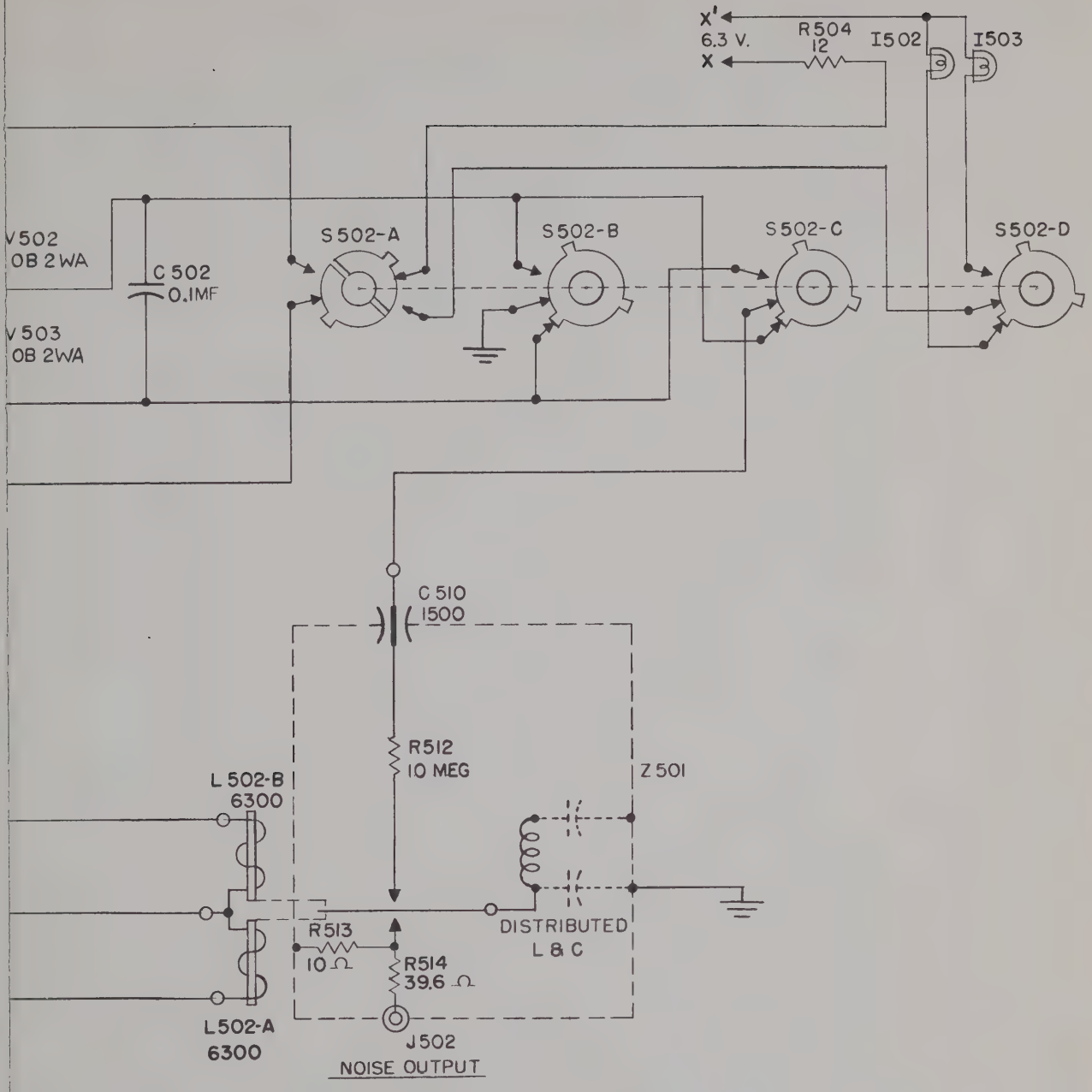
6. POWER SUPPLY PP-530/URM-17

(See Figure 2-29.) The RI-FI Meter Power Supply PP-530/URM-17 is designed for operation from any a-c power source of 105 to 125 volts or 210 to 250 volts at any frequency between 50 and 400 cycles per second; however, the remaining units of the AN/URM-42 equipment are unable to operate on the 210 to 250 volt supply, limiting overall operation of the equipment to the 105 to 125-volt supply.

A-C power input is connected to the unit through POWER INPUT receptacle J302. Fuses F301 and F302 are provided to protect the power transformer against overloads or internal short circuits. DPDT POWER switch S301 controls the application of a-c power, through r-f isolation filter Z301, to the primary of power transformer T301. Switch S302 should be maintained in the 115-volt position at all times. An input designating tag on the front panel must be manually positioned to indicate the existent setting of this switch.

Regulated 225-volt d-c power for the plate supply circuits of the RI-FI Meter is derived from the twin triode tube V301 which is utilized as a combination full-wave rectifier and series regulator. Neon glow lamp V303 is used to establish a reference voltage at the cathode of control tube V302. The voltage at the control grid of tube V302 is determined by the setting of regulator adjusting potentiometer R308 which is connected in a positive voltage divider across the 225-volt output. When the voltage at the 225-volt output bus rises, due to a decreased load or fluctuations in the a-c supply, the voltage at the control grid of tube V302 rises. The grid is normally held approximately 2.5 volts negative with respect to the cathode and increasing the voltage causes the tube to conduct more heavily than normal, drawing an increased plate current. through resistor R304. The voltage at the plate of tube V302, therefore, and, coincidentally, at the grids of tube V301, drops, decreasing the rate of conduction of tube V301. The voltage developed across the voltage divider, of which R308 is a part, is, therefore, lowered, lowering the voltage at the grid of tube V302, and completing an effective servo loop. Operation of the circuit is precisely opposite when the voltage appearing across the voltage divider is falling.

The rectifier filter circuit uses high-capacity electrolytic capacitors in a resistance-capacitance filter. Part of the filter resistance, R312 and R313, is in the common negative lead through which the relatively constant plate supply passes. The voltage across resistors R312 and R313 constitutes the RI-FI Meter bias supply of -17 volts. The RI-FI Meter a-c heater supply voltage of 6.3 volts is obtained from a separate winding of the power transformer T301 and is provided with a moderate degree of regulation through the action of thermal voltage regulator R301.



SWITCH NOTE —

SWITCH SECTION S 502-A, PULSE OFF - ON
SECTIONS S 502-B,C,D STEP DRIVEN COUNTER-
CLOCKWISE FROM S 502 A

Figure 2-30, Generator, Interference SG-112/URM, Schematic Diagram

C163 and inductor L122 is an i-f filter designed to reject the 60-megacycle i-f voltage.

(3) The Quasi-Peak Circuit:

In the quasi-peak function, the time constants of the detector weighting circuits are approximately one millisecond charge and 600 milliseconds discharge. For pulse signals several microseconds or more in width and with a pulse repetition frequency (PRF) of 1000 per second or greater, the meter indication is near the peak value of an interfering signal as seen at the output of the second detector. For pulses sharp with respect to the reciprocal of the bandwidth (one microsecond) measurements can be made of a signal with a PRF as low as 120 pulses per second. At this PRF, the ratio of PEAK to QP readings is approximately 10-to-1 and so a full-scale QP reading represents a pulse amplitude at the output of the second detector which is in the dynamic range limit (20-db) of the equipment. The diode load resistor is R167 and the weighting circuit charge-discharge action is accomplished by capacitor C164 across the diode load. I-F Filter Z111 rejects the 60-mc i-f voltage.

QP 1 potentiometer R179 functions in the same manner as did potentiometer R181 described in paragraph 5j(2). A separate potentiometer is employed because the actual bucking potential is different than that required in the field intensity position of the function switch due to the different diode loads. Quasi-peak meter indications are adjusted to be the same as those in the field intensity function, using the same unmodulated signal, by adjustment of the QP 100 potentiometer R178.

(4) The Peak Circuit:

In the peak function, the circuit is similar in some respects to the field intensity circuit described in subparagraph 5j(2). The VTVM and AGC circuits are the same, but an additional bias circuit R170 has been added to enable the measurement of peak signal values. The peak value measured is the peak as seen by the second detector and not the true peak of the signal at the antenna input. The PEAK function of the function switch acts to apply a d-c voltage in parallel with the signal input. The circuit is similar to an adjustable delayed AGC system, since the d-c voltage is also applied to the detector V110. The d-c voltage is manually adjusted to the threshold of diode rectification. This measurement technique is similar to that employed in the "slide-back" voltmeter. For any given measurement at the low end of the meter scale, the PEAK BUCK control R180 equalizes the meter reading obtained in the peak position of the function switch with that obtained in the field intensity position.

6. POWER SUPPLY PP-530/URM-17

(See Figure 2-29.) The RI-FI Meter Power Supply PP-530/URM-17 is designed for operation from any a-c power source of 105 to 125 volts or 210 to 250 volts at any frequency between 50 and 400 cycles per second; however, the remaining units of the AN/URM-42 equipment are unable to operate on the 210 to 250 volt supply, limiting overall operation of the equipment to the 105 to 125-volt supply.

A-C power input is connected to the unit through POWER INPUT receptacle J302. Fuses F301 and F302 are provided to protect the power transformer against overloads or internal short circuits. DPDT POWER switch S301 controls the application of a-c power, through r-f isolation filter Z301, to the primary of power transformer T301. Switch S302 should be maintained in the 115-volt position at all times. An input designating tag on the front panel must be manually positioned to indicate the existent setting of this switch.

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The rectifier filter circuit uses high-capacity electrolytic capacitors in a resistance-capacitance filter. Part of the filter resistance, R312 and R313, is in the common negative lead through which the relatively constant plate supply passes. The voltage across resistors R312 and R313 constitutes the RI-FI Meter bias supply of -17 volts. The RI-FI Meter a-c heater supply voltage of 6.3 volts is obtained from a separate winding of the power transformer T301 and is provided with a moderate degree of regulation through the action of thermal voltage regulator R301.

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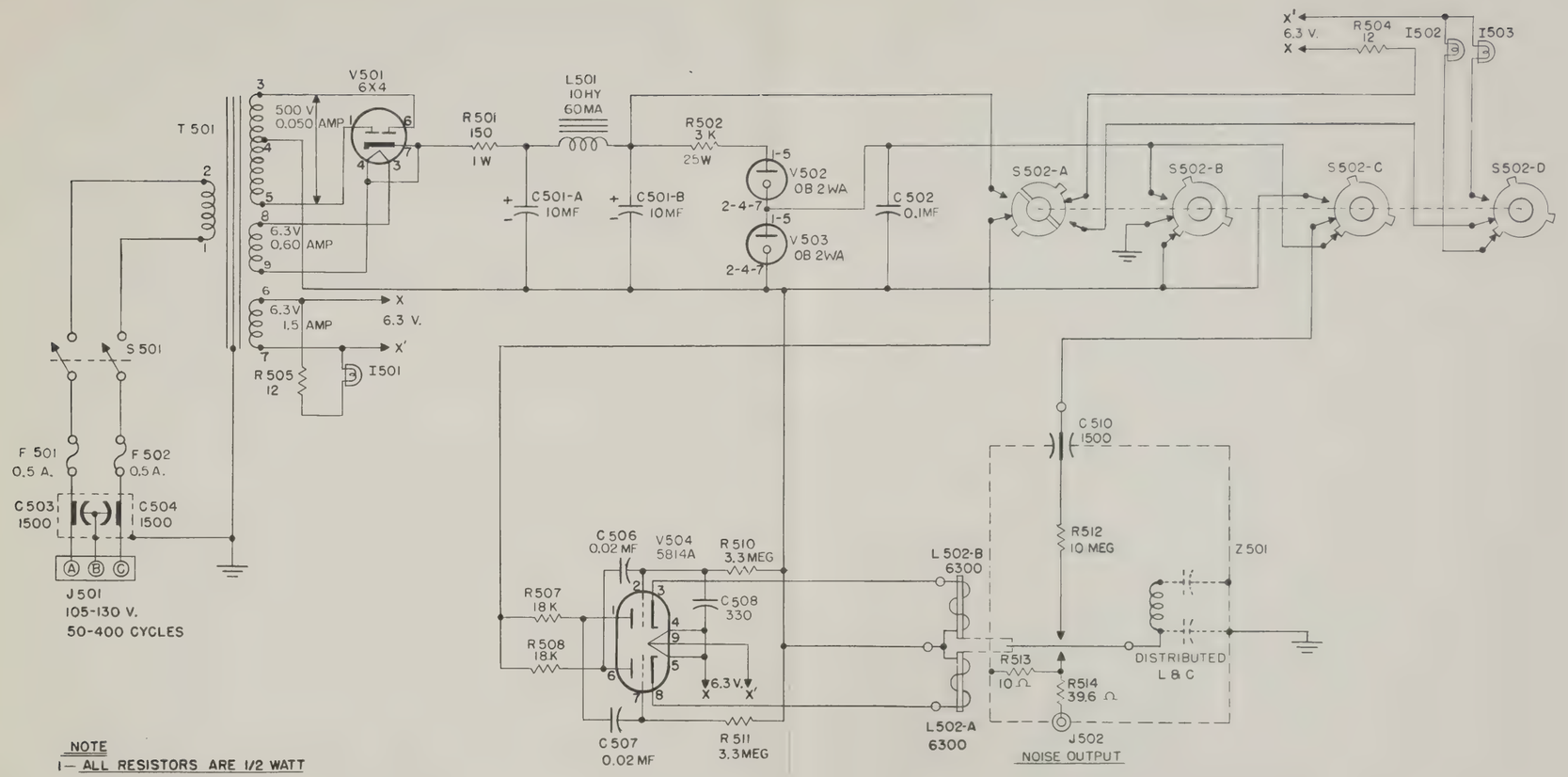
AN/URM-42



NOTE

1— ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE NOTED.

2— RESISTANCE VALUES IN OHMS, UNLESS FOLLOWED WITH "K"— KILOHMS (1,000 OHMS) OR "MEG" MEGOHMS (1,000,000 OHMS).

3— CAPACITANCE VALUES IN MICRO—MICROFARADS UNLESS FOLLOWED WITH "MF"— MICROFARADS.

SWITCH NOTE —

SWITCH SECTION S 502-A, PULSE OFF - ON SECTIONS S 502-B,C,D STEP DRIVEN COUNTER - CLOCKWISE FROM S 502 A

Figure 2-30, Generator, Interference SG-112/URM, Schematic Diagram

7. GENERATOR, INTERFERENCE SG-112/URM

(See Figure 2-30.) Generator, Interference SG-112/URM, hereinafter referred to as the impulse noise generator, consists of a power supply, a multivibrator, an impulse noise line, and a polarity-switching circuit. The unit functions to provide r-f calibrating voltages to the RI-FI Meter, through the R-F Tuner in use, over an extremely broad portion of the radio-frequency spectrum.

The impulse noise line consists of a length of brass coaxial line whose inner conductor is broken for a short length to form a concentric chamber having the same diameter as the normal inner conductor. The dielectric material between the inner and outer conductors is continuous and forms the outer wall of the chamber. A small concentric contactor is installed in the chamber whose diameter is slightly smaller than the normal inner conductor and whose length is shorter than the length of the chamber. The contactor, therefore, is free to move axially within the chamber and is provided with fixed, concentrically-placed, small-diameter platinum contacts at both ends to assure positive contact with mating contacts mounted on the inner conductor at either end of its travel. Two coils are mounted concentrically around the outer conductor, about the center of the chamber. Ferrous material encloses each coil except for a gap adjacent to the contactor. These coils are alternately energized through the action of a multivibrator V504. The magnetic field set up by one coil is directed across the associated gap by the ferrous material path, forcing the contactor, which also contains ferrous material, in a direction which will close the magnetic gap. Contactor movement stops at the end of the chamber with the closing of the contacts. The magnetic field of the second coil functions to draw the contactor to the opposite extreme of the chamber. The movable, concentric contactor, in combination with the outer donductor of the line constitutes a tuned circuit having finite values of distributed inductance and capacitance. When the contactor is at the charging end of its travel, a voltage is applied to the contactor through a charging resistance which charges the contactor, with respect to the outer conductor, to the supply voltage. When the multivibrator "flips," the coil which drew the contractor to the charging contact is de-energized and the second coil is excited, moving the contractor almost instantaneously to the discharge end of its travel. When the discharge contacts close, the contactor discharges through the external load. This discharge is very rapid and generates a pulse having a very short rise time and, therefore, a very high harmonic content. The impulse voltage is isolated from the power supply by the air gap which exists, at that time, between the contractor and the charging contact (0.005 to 0.015 inch), the 10-megohm charging resistor, and the 1500-micromicrofarad feed-through capacitor. The charging resistor and feed-through capacitor are installed within the outer conductor on the line at the charging end of the assembly. The pulse output of the impulse noise line is delivered to the output receptacle J502.

Tube V504 is a free-running multivibrator and supplies the square wave alternate field excitation to the two coils of the impulse noise line. The circuit operates at a pulse repetition frequency of approximately 20 pulses-per-second. Capacitor C508 provides initial unbalance to the multivibrator. Power is supplied to the multivibrator circuit whenever switch S502 is thrown to the ON position.

Switch S502 is a somewhat unconventional four-deck wafer switch. Deck A has but two positions which are 60 degrees apart; however, decks B, C, and D have six positions and are connected to deck A through a ratchet mechanism. Each time the switch is turned to the ON position, decks B, C, and D rotate 60 degrees, but do not return to their former positions when the switch is thrown to the OFF position. Since each of the rotors of these decks has three common sliders, 120 degrees apart, one of these sliders is always in contact with one of the two fixed contacts of each deck. Decks B and C, due to the manner of their connection, function to reverse the polarity of the voltage applied to the impulse noise line every time the unit is operated. This precaution is necessary to neutralize metal transfer between the fixed and movable contacts of the impulse noise line. Deck D of S502 serves to light an appropriate indicating lamp, I502 or I503, on the front panel of the unit: red for positive polarity, and green for negative pulse polarity.

The power supply utilizes a conventional full-wave rectifier and filter circuit to provide B+ and B- voltages to the multivibrator and impulse noise line. The power supply output is regulated at 210 volts by two series-connected cold-cathode voltage regulator tubes V502 and V503. Power input to the power supply is controlled by POWER switch S501.

SECTION 3

INSTALLATION

1. SCOPE OF THIS SECTION

Procedures for setting up the AN/URM-42 equipment in a condition ready for operation are given in this section; however, actual operating procedures are contained in the succeeding Section 4, Operation. Radio Interference Measuring Set AN/URM-42 is portable test equipment and no provisions are made for permanent mounting.

2. POWER SUPPLY REQUIREMENTS

Radio Interference Measuring Set AN/URM-42 will always be operated with an external power source supplying a-c power to the equipment. The detail requirements of this power source are contained in the electrical characteristics listing of paragraph 3, Section 1.

3. INITIAL EQUIPMENT SETUP

a. Normal Setup: (See Figure 3-1.)

Step 1. Place Case, Radio Interference Measuring Set CY-1648/URM-42 on a convenient table or other flat surface. Detach the top and front removable covers of the case. The two covers can be secured together utilizing the buckles provided for this purpose.

Step 2. Place Case, Power Supply CY-1650/URM-42 next to or near Case CY-1648/URM-42 and detach its top and front removable covers. The two covers can be secured together utilizing the buckles provided for this purpose.

Step 3. Locate Case, Tuner CY-1649/URM-42 near the Case CY-1648/URM-42 and open the hinged front cover.

Step 4. If the R-F Tuner installed in Case CY-1648/URM-42 is not appropriate to the frequency range of the tests to be conducted, loosen the wing-nut fasteners securing that tuner in that case and those securing the appropriate tuner in the Tuner Case. Interchange the positions of the two tuners and secure their respective fasteners.

Step 5. Lift Antenna AT-522/URM-42 from its position atop the plastic cable container in case CY-1648/URM-42, permitting access to all equipment cables except cable assembly CX-2967/U(6' 0") which is stored in the power supply case.

Step 6. Connect the power cable (CADV-62481 (10'0")) (W1105) between the POWER receptacle of the RI-FI meter and the POWER OUTPUT receptacle of the RI-FI meter power supply.

Step 7. Connect one of the three power cables (Cable Assembly CADV-62480 (6'0") (W1101, W1102, or W1103) between the POWER INPUT receptacle of the RI-FI Meter Power Supply PP-530/URM-17 and one of the dual receptacles labelled 115V. 50-400~ on the R-F Tuner Power Supply PP-1179/URM-42.

Step 8. Connect one of the two remaining power cables (CADV-62480 (6'0") between the POWER INPUT receptacle on the impulse noise generator (SG-112/URM-42) and the other of the dual receptacles labelled 115V. 50-400~ on the R-F Tuner Power Supply PP-1179/URM-42.

Step 9. Connect power cable W1104 (CX-2967/U(6'0") (stored in the power supply case) between the OUTPUT receptacle on the end of the R-F tuner Power Supply PP-1179/URM-42 and the receptacle labelled P101 on the R-F Tuner in use.

Step 10. Connect one of the R-F cables (CG-92D/U(3'0") (CADV #90933-2) between the PULSE OUTPUT receptacle of the impulse noise generator (SG-112/URM-42) and the receptacle corresponding to position 1 of the input coaxial switch (SA-352/U).

Step 11. Connect the remaining R-F Cable (CG-92D/U (3'0") between the centrally-located receptacle on the coaxial switch (SA-352/U) and the receptacle labelled P102 on the R-F Tuner in use.

Step 12. Connect R-F Cable W1106 (CG-530/U (4'5") between the receptacle labelled P103 on the R-F tuner in use and the IF INPUT receptacle on the RI-FI meter (IM-103/URM-42).

Step 13. Connect the R-F transmission line (Cable Assembly CG-92D/U (20'0") to the receptacle corresponding to position 2 of the coaxial switch (SA-352/U).

Step 14. Connect the R-F transmission line (Cable Assembly CG-92D/U(6'0") to the receptacle corresponding to position 3 of the coaxial switch.

Step 15. If the equipment is to be used as a field intensity meter, open the zipper closures on Tripod Bag CW-218/URM-17 and remove the Tripod CADV-10545. Loosen the upper knob on each leg, spread the legs as needed for adequate stability, and tighten the upper lock knobs. The extension portions of the tripod legs are removable, with one end fitted with a rubber foot for use on hard surfaces and the other end with a steel spike for use on soft surfaces. Loosening the lower lock knob of each leg permits the extension portions to be lengthened. The lower lock knobs must be removed to reverse the extension portions.

Step 16. The Azimuth Bearing Dial Assembly is inverted on the tripod head for stowing in the

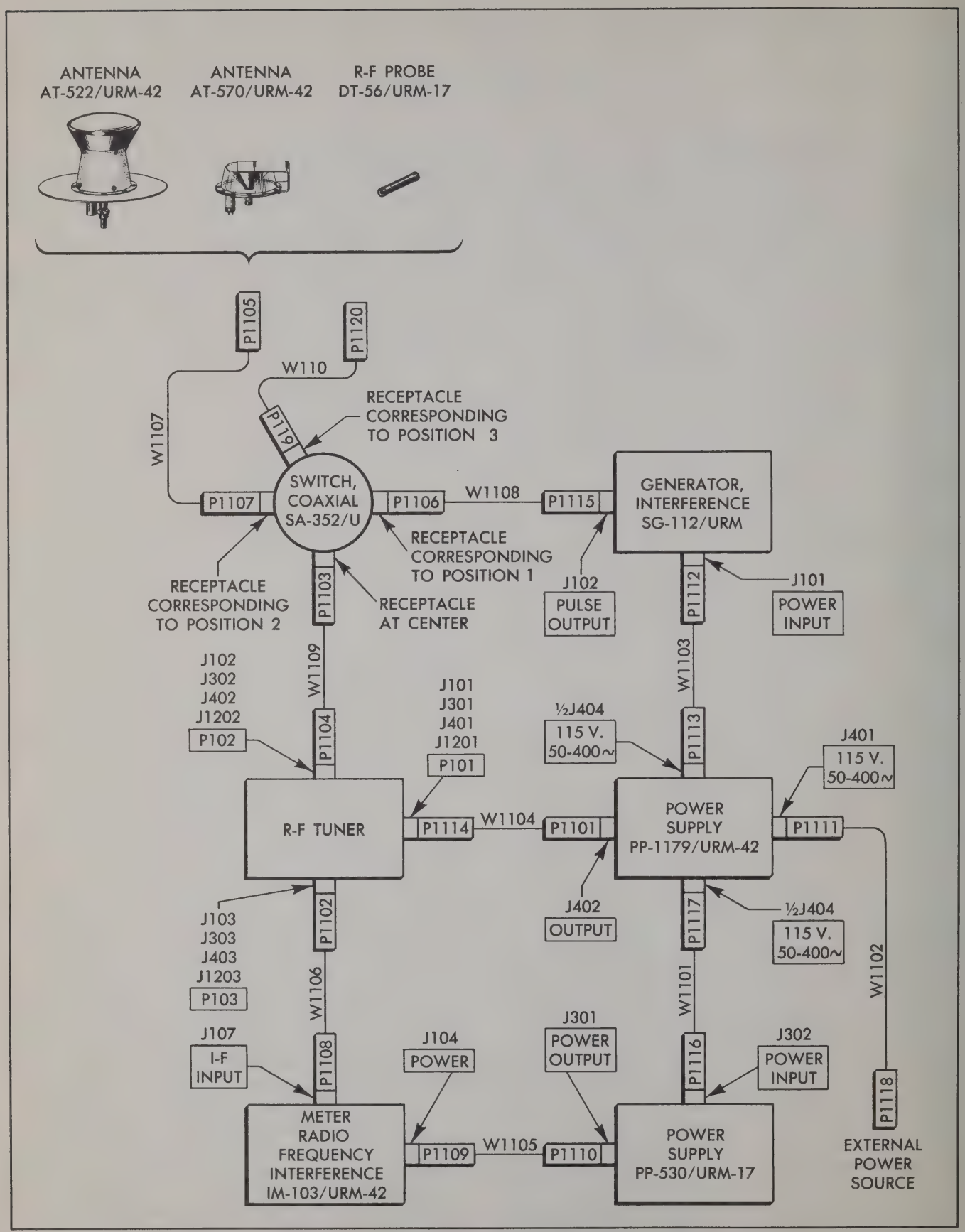


Figure 3-1, Radio Interference Measuring Set AN/URM-42, Cabling Diagram

Tripod Bag in order to protect the sighting pins in the dial. Loosen the lock screw on the azimuth dial and slide it off the sleeve on the tripod head. Then, with the azimuth dial facing up, slip the assembly in place on the tripod head. The azimuth dial must be oriented to magnetic north before being locked to the tripod head when directive measurements are to be used for locating a signal source.

Step 17. Remove Antenna Mast Section AB-189/URM-17 from the pocket in the Tripod Bag.

Step 18. Remove the small cone antenna (AT-570/URM-42) from the Case, Radio Interference Measuring Set CY-1648/URM-42 and connect the free end of the transmission line to the receptacle at the base of the antenna. Secure the antenna to the antenna mounting bracket (holder, antenna AB-413/URM-42) (stored in the measuring set case) and mount the assembly at the top of the antenna mast section and place the mast section in the sleeve on the tripod head. The cone, antenna, antenna mounting assembly, and antenna mast section are keyed to one another in such a way that the azimuth pointer at the base of the mast section indicates the direction of maximum directivity of the cone. In the event that antennas other than those supplied are to be used, the azimuth pointer must be set to the direction of the antenna's maximum directivity. The pointer can be reset by loosening the set screws securing the pointer to the mast, adjusting the pointer position, and tightening the set screws.

NOTE

ONLY TWO CONE ANTENNAS ARE SUPPLIED WITH THE AN/URM-42 EQUIPMENT. DUE TO THE NATURE OF THE RECEPTION PATTERNS OF THIS TYPE OF ANTENNA, THE DIRECTION OF A RECEIVED SIGNAL CANNOT NORMALLY BE DETERMINED. HOWEVER, A DIRECTIONAL SHIELD IS PROVIDED FOR THE SMALL CONE WHICH PERMITS THE INCIDENT SIGNAL AZIMUTH ANGLE TO BE DETERMINED.

The larger cone antenna is to be used only under conditions where approximate intensity measurements are sufficiently accurate for the purpose and only within the frequency range of 1 to 3 kilomegacycles. No directional shield is provided for this antenna.

Step 19. If the equipment is to be used as a two-terminal voltmeter, remove the R-F Probe DT-56/URM-17 from its position in the CY-1648/URM-42 case and connect it to the free end of the R-F transmission line (CG-92D/U(20'0") or CG-92D/U(6'0").

b. Optional Setup:

Certain accessories supplied with related equipments can be used with Radio Interference Measuring Set AN/URM-42 to facilitate field operations as indicated in table 3-1. The use of these items will be briefly described here:

Topography of the survey site may require the antenna site to be up to twenty feet distant from the location of the metering equipment. Under these conditions, it would be convenient to use a remote ammeter (selected from table 3-1) at the antenna when adjusting the antenna in use for maximum response. Since none of the ammeters are identical to the panel mounted indicating meter, remote meter indications must be converted. When utilizing this arrangement, the remote meter cable listed in table 3-1 must be utilized to connect the remote meter to the REMOTE METER receptacle on the IM-103/URM-42 meter unit. It might also be desirable to aurally monitor reception when orienting the antenna: a headphone extension cable is listed in table 3-1 for this purpose.

It may be desirable to use Milliammeter-Recorder RD-59/U to make graphic recordings. In this case, a source of 115 volt, 60-cps a-c power must be available for the synchronous motor in the recorder. The recordings will be approximations only, in view of the fact that the chart ruler supplied with the recorder is not calibrated for use with Radio Interference Measuring Set AN/URM-42. However, a new chart ruler can be calibrated by using the RI-FI Meter scale as a reference. Connect the recorder to the REMOTE METER receptacle on the IM-103/URM-42 meter unit by means of the appropriate cable listed in table 3-1. Using the PEAK function of the meter, adjust the PEAK control to obtain indicating meter readings at the main calibration points on the meter scale. Place a strip of clear plastic across the recorder chart and score the plastic at the points obtained from the chart record.

Antenna AS-23/AP is a dipole (with reflector) which is applicable to the frequency range of 1550 to 5200 megacycles. Antenna AT-48/UP is a horn which covers the 5200 to 11.000 megacycle portion of the r-f spectrum. Both of these antennas are directional and, with certain reservations, can be used for determining the azimuth and inclination angles of intercepted signals or noise sources. However, means for mounting these antennas on the antenna mast section must be improvised which will permit orientation of the antenna with magnetic north and, in addition, antenna factors must be calculated if accurate intensity measurements are to be made.

c. Connecting to External Power Source:

The external power source must supply 105-125 volt, 50-400-cps power to the AN/URM-42 equipment. Connect the remaining power cable (CADV-62480) (6'0") (W1101, W1102, or W1103) between the single receptacle labelled 115 V. 50-400 ~

Table 3-1, Optional Accessories

ACCESSORY	PARENT EQUIPMENT	OPTIONAL USE
Ammeter ME-31/U	AN/URM-6	Remote Meter Indication
Ammeter ME-33/U	AN/PRM-1	Remote Meter Indication
Ammeter ME-76/U	AN/URM-47	Remote Meter Indication
Special Purpose Cable Assembly CG-571/U (20'0")	*	Remote Meter Cable
Antenna AS-23/AP	- - - - - - - -	Directional Antenna
Antenna AT-48/UP	- - - - - - - -	Directional Antenna
Milliammeter - Recorder RD-59/U	AN/URM-6	Graphic Recordings
Special Purpose Cable Assembly CG-571/U (6'0")	AN/URM-6	Milliammeter-Recorder Cable
Observer Compass, Mark 1, Mod 0	AN/URM-6	Orient Directional Antennas
Special Purpose Cable Assembly CG-572/U (20'0")	*	Headphone Extension Cable

* Supplied with AN/PRM-1, AN/URM-6, and AN/URM-47 equipments.

on the R-F tuner Power Supply PP-1179/URM-42 and the external power source.

Connect a good ground to one of the GROUND binding posts of the equipment or to the third conductor of power cable CADV-62480 (6'0"). Only one ground point should be used because grounding more than one creates a loop in conjunction with the interconnecting cables. To avoid making a loop, make certain the case of any ungrounded unit is not inadvertently grounded by making contact with a steel deck or the earth.

4. INITIAL ADJUSTMENTS

a. Electrical Adjustments:

All internal alignment and calibration adjustments on Radio Interference Measuring Set AN/URM-42 are made at the factory and no further adjustment is required in the field prior to operation.

b. Operational Check:

It is recommended that the following operational checks be made when the equipment has been set up for operation:

Step 1. With the power turned OFF, check the mechanical zero of the front panel meter on meter unit IM-103/URM-42. If the pointer is off zero, correct as necessary by means of the screw on the face of the meter.

Step 2. Turn the ON-OFF switch on the R-F tuner power supply (PP-1179/URM-42) ON; the red lamp on the power supply panel should be illuminated.

Step 3. Turn the POWER ON-OFF switch on Power Supply (PP-530/URM-17) front panel to the ON position; the pilot lamp on the panel should be illuminated.

Step 4. Turn the POWER ON-OFF switch on the impulse noise generator SG-112/URM front panel to the ON position; the pilot lamp on the panel should be illuminated. The equipment is ready for operation after a suitable warmup period.

Step 5. Adjust the CAL control on the RI-FI meter unit IM-103/URM-42 fully counterclockwise.

Step 6. Set the Function Switch on the RI-FI meter unit to the FI position.

Step 7. Set the Attenuator Switch on the RI-FI meter unit to the $X10^2$ position.

Step 8. Set Coaxial Switch SA-352/U to position 1. The indicating meter M101 on the RI-FI meter unit should show a slight deflection above zero (approximately 1%, or 1/16 inch, of full scale). If the meter indicates an appreciable deflection in either direction of more than 1%, an internal adjustment may be required (refer to the instructions contained in paragraph 4c). If no adjustment is required, continue the operational check.

Step 9. Set the Function Switch on the RI-FI meter unit to the PEAK position.

Step 10. Set the PULSE ON-OFF switch on the impulse noise generator SG-112/URM to the ON position.

Step 11. Adjust the PEAK control on the RI-FI meter unit for the output meter indication found on Calibration Chart pages 2 or 3 for the frequency at which the R-F Tuner is set. A slight lag will be noted in the affect of the PEAK control. Set the Attenuator Switch on the RI-FI meter unit to the position dictated by the pertinent Calibration Chart reading.

Step 12. Rotate the CAL control on the RI-FI meter unit slowly in a clockwise direction until pulses from the impulse noise generator (approximately 15 to 20 per second) can be heard in the headphones. Then rotate the control counterclockwise until the pulses just become inaudible. Do not advance the CAL control beyond the point of inaudibility or an erroneous gain setting will result. The equipment is now standardized for gain. If this test is successful, the gain normalization features of the equipment are operating satisfactorily.

Step 13. Set the Function Switch on the RI-FI meter unit to the field intensity (FI)position. Using an appropriate antenna, tune through the range of the R-F Tuner listening for signals to determine that the equipment operates throughout the band. Select a RI-FI meter Attenuator Switch setting for an on-scale meter indication and an AUDIO control setting suitable to give a comfortable audio volume level in the headphones. Repeat this procedure using each of the four R-F Tuners.

Step 14. Check the slide-back feature of the equipment as follows: With the antenna still connected, and with the equipment tuned to a modulated (or noise) signal, turn the Function Switch on the RI-FI meter unit to the PEAK position. From its fully counterclockwise position, turn the PEAK control on the RI-FI meter unit slowly in a clockwise direction until the received headphone signal just becomes inaudible. Do not advance the PEAK control beyond the point of inaudibility or an erroneous meter indication will result. Take into account the slight lag in action of the PEAK control. Observe the pointer of the indicating meter on the RI-FI Meter front panel as the point of inaudibility is approached. If the pointer goes off-scale, set the Attenuator Switch to the next higher position, using the required PULL-TURN-PUSH sequence. Return the PEAK control to the fully counterclockwise position, then readjust until the headphone signal just becomes inaudible.

c. Meter Zero Adjustment:

In the event that operational check step 8 in paragraph 4b indicates adjustment of the electrical zero is required, the chassis of the RI-FI meter unit must be removed from the case (refer to paragraph 3d, Section 5) and an adjustment made. Up-end the chassis on a flat surface. Connect a temporary jumper across the two terminals marked METER on the terminal board. Then adjust the screwdriver control adj zero (R196), located on top of the chassis directly behind the indicating meter, for an exact zero indication on the meter. Tighten the locknut on R196 and remove the temporary jumper. Check that the meter then reads approximately 1% full scale (1/16 inch) when repeating step 8. If the meter shows an appreciable deflection of more than 1% full scale, the FI Buck control R181 may be out of adjustment. In this case refer to the instructions contained in section 5, paragraph 8.

d. Orienting Directional Antennas:

Approximate magnetic bearings of a signal source can be obtained with Radio Interference Measuring Set AN/URM-42 using directional antennas. However, the antenna selected for use must be oriented with respect to the azimuth dial pointer. When the azimuth dial has been oriented with respect to magnetic north, the approximate bearing of the signal source is given directly by the pointer on the azimuth circle on the tripod head. It should be noted that the azimuth dial must be reoriented each time the tripod is moved from one location to another. Observer-Compass MARK 1, Mod O (not furnished) can be used for this orientation procedure.

The observer-compass was designed for obtaining distant shore bearings from a ship. It consists of a liquid-filled compass bowl and card with a means of illuminating the card, and a prism for permitting direct reading of the card while sighting upon an object. A two-cell flashlight of non-ferrous construction, without the usual head containing lens and reflector, is fitted into the bottom of the compass bowl. The light from the flashlight bulb passes through a red plate to the translucent compass card. A switch on the side of the flashlight turns the light on and off. The prism above the compass is hinged to provide an adjustment in the angle between the line of sight from the eye to the distant point being observed and the image of the compass card in the prism. An open sight is also provided on the prism mounting. The lubber line above the compass card functions as the other sight in alignment with the object on which bearings are being taken.

NOTE

IRON OBJECTS SHOULD BE REMOVED FROM POCKETS AND ALL METALLIC TOOLS ETC., SHOULD BE REMOVED FROM THE VICINITY BEFORE READING THE MAGNETIC COMPASS. MAGNETIC COMPASSES ARE PARTICULARLY UNRELIABLE NEAR POWER LINES AND NEAR METALLIC STRUCTURES.

To orient the azimuth dial, temporarily remove the antenna and antenna mast. Turn the azimuth

dial so that zero is at the north side as close as can be estimated. Hold the compass upright and level in the hands, or if possible, resting upon a support of suitable height. Take a position such that the open sight above the prism of the compass is on a level with the sighting pins of the azimuth dial. Adjust the prism up or down until the compass card can be seen clearly. Then vary the position of the observer until the compass reads exactly north (360 degrees), the open sight and the lubber line are exactly in line with the 360-degree mark, and the line of the sight passes directly over both of the sighting pins of the azimuth dial. It will be necessary to turn the dial to adjust its position as successive sights are taken with the observer-compass, until the desired alignment is attained. At this point, tighten the lock screw on the azimuth dial, being careful not to move the dial while doing so.

There is an efficient bubble trap around the periphery of the compass bowl. If a bubble appears during use of the compass, turn the compass upside down and slowly return it to the upright position. This puts the bubble behind the bubble trap where it will not be visible nor disturb the action of the compass card.

Place the mast section in the sleeve on the tripod head. Tighten the mast screw under the tripod head to secure the mast to the tripod. Check that the index line on the azimuth dial indicator on the base of the mast coincides with the plane of maximum azimuth directivity of the antenna. Also check the clearance between the azimuth dial and pointer. If necessary, the azimuth pointer can be moved as follows: Loosen the two set screws on the pointer with an Allen wrench. With the pointer at the proper position to provide a clearance above the azimuth dial (1/32 inch), turn the pointer to bring the index line in line with the plane of maximum directivity. Tighten the two set screws. Make certain that the spring steel collar inside the azimuth pointer is in place when the set screws are tightened.

SECTION 4

OPERATION

1. INTRODUCTION

Radio Interference Measuring Set AN/URM-42 is basically a meter intended for intensity measurements of all types of r-f energy in the 1.0 to 10.75 kmc/s portion of the radio-frequency spectrum.

The equipment includes a sensitive receiver and a vacuum-tube voltmeter (VTVM) section. It also contains means for standardizing the receiver gain.

In operation, the type of measurement is selected by means of the Function Switch on Meter, Radio Frequency Interference IM-103/URM-42. The FI (field intensity) function of the meter affords measurement in terms of the average value, the QP (quasi-peak) function is derived by the use of a weighted detector circuit, and the PEAK function in terms of the peak value of the signal or interference at the second detector.

The IM-103/URM-42 meter unit measures the effect of the peak value of an interfering pulse. It does not measure absolute peak value of the pulse because such response is dependent upon the effective bandwidth, the energy of the pulse (product of amplitude and duration), and the second detector characteristics of the measuring equipment. The duration of the impulse, after passing through the various tuned circuits, is roughly proportional to the reciprocal of the RI-FI meter effective bandwidth. The envelope of the pulse applied to the second detector differs from the input pulse envelope. Its peak amplitude is less than that of a sine wave signal having the same peak value as the original impulse. Tuned circuits in the RI-FI meter shape the pulse so that its peak amplitude is decreased and its duration is lengthened. The RI-FI meter intergrates the spectrum of the impulse over the passband around the signal frequency and measures the peak value of the shaped impulse. This value can be converted to a per-megacycle-bandwidth basis by application of a factor depending upon the bandwidth of the RI-FI meter. When expressed in terms of per-megacycle-bandwidth, the results can be correlated with similar readings obtained from other measuring equipments expressed in the same units.

2. EQUIPMENT CONTROLS AND RECEPTACLES

All operating controls of Radio Interference Measuring Set AN/URM-42 are located in accessible positions on the various units, i.e., front panels; in a like manner, the receptacles to which external connections are made are placed in readily available locations.

The function of each control and receptacle is normally described by an adjacent panel marking or by panel markings identifying the various control positions. In Table 4-1, the panel marking or legend is explained and the applicable symbol designation is given in parentheses after the legend to aid in identifying the circuit component.

Table 4-1, Designation and Function of Panel Controls and Receptacles

Legend	Function
	ON THE R-F TUNERS
TUNE	Operates the ganged preselector and local oscillator cavities to vary tuning of the unit.
P101	Receptacle for connection of operating potentials.
P102	Receptacle for connection of input r-f signal from coaxial switch.
P103	Receptacle for connection of output i-f signal to the RI-FI Meter.
	ON THE R-F TUNER POWER SUPPLY
ON-OFF (S401)	
ON position	Energizes the R-F Tuner in use.
OFF position	De-energizes the R-F Tuner in use.
MIXER XTAL (J403)	Permits monitoring of the R-F Tuner mixer current.

Table 4-1, Designation and Function of Panel Controls and Receptacles (cont'd)	
Legend	**Function**
POWER 115 V. 50-400 (J401)	Receptacle for connection of power from external source.
115 V. 50-400 (J404-dual receptacle)	Dual receptacle for connection of a-c power to Power Supply PP-530/URM-17 and the Generator, Interference SG-112/URM.
OUTPUT (J402)	Receptacle for connection of operating potentials to the R-F Tuner in use.
RECORDER DRIVE (J405)	Receptacle for connection of a-c power to a graphic recorder (not supplied).
	ON METER, RADIO FREQUENCY INTERFERENCE IM-103/URM-42
REMOTE METER (J101)	Receptacle for connection of an external meter.
I-F INPUT (J107)	Receptacle for connection of the i-f input signal from the R-F Tuner in use.
POWER (J104)	Receptacle for connection of operating potentials.
SCOPE (J108)	Receptacle for connection of an external oscilloscope.
AUDIO OUTPUT 600 OHMS (J102 and J103)	Headphone receptacles for aural monitoring.
PULL-TURN-PUSH (S101, E115 thru E120)	
X10 +20 db position	Does not attenuate 160 mc or 60 mc signal. Does include an X10 factor of 20 db to correct for output meter scale marking.
$X10^2$ +40 db position	Does not attenuate 160 mc signal. Attenuates 60 mc signal 10 times or 20 db. Includes an X10 factor or 20 db to correct for output meter scale markings.
$X10^3$ +60 db position	Attenuates 160 mc signal 10 times or 20 db. Attenuates 60 mc signal 10 times or 20 db. Includes an X10 factor or 20 db to correct for output meter scale markings.
$X10^4$ +80 db position	Attenuates 160 mc signal 100 times or 40 db. Attenuates 60 mc signal 10 times or 20 db. Includes an X10 factor or 20 db to correct for output meter scale markings.
$X10^5$ +100 db position	Attenuates 160 mc signal 1000 times or 60 db. Attenuates 60 mc signal 10 times or 20 db. Includes an X10 factor or 20 db to correct for output meter scale markings.
CAL (R136)	Adjusts gain of 60 mc i-f section to standardize receiver gain.
FUNCTION SWITCH (S102)	
FI position	Weights signal for field intensity measurements.
QP position	Weights signal for quasi-peak measurements
PEAK position	Furnishes dc to detector for slide-back voltage measurements.

Table 4-1, Designation and Function of Panel Controls and Receptacles (cont'd)	
Legend	**Function**
PULSE STRETCHER-OFF (S103)	
PULSE STRETCHER position	Increases audio volume level when tuning narrow pulse signals.
OFF position	Disables the pulse stretcher circuits.
AUDIO (R213)	Controls aural (headphone) monitoring level.
PEAK (R170)	Furnishes slide-back voltage for measuring peak voltages.
	ON POWER SUPPLY PP-530/URM-17
POWER OUTPUT (J301)	Receptacle for connection of operating potentials to RI-FI Meter.
POWER INPUT (J302)	Receptacle for connection of input power from the external source.
GROUND	Ground post for connection to an external ground.
POWER (S301)	
ON position	Energizes the RI-FI meter.
OFF position	De-energizes the RI-FI meter.
	ON GENERATOR, INTERFERENCE SG-112/URM
POWER (S101)	
ON position	Energizes the impulse noise generator.
OFF position	De-energizes the impulse noise generator.
PULSE (S102)	
ON position	Energizes the impulse noise line.
OFF position	De-energizes the impulse noise line.
POWER INPUT (J101)	Receptacle for connection of input a-c power.
PULSE OUTPUT (J102)	Receptacle for connection of impulse noise output to Coaxial Switch.
	ON COAXIAL SWITCH SA-352/U
COAXIAL SWITCH (S601)	
1 position	Connects output of theimpulse noise generator to the input of the R-F Tuner in use.
2 position	Connects antenna in use to the input of the R-F Tuner in use.
3, 4, 5 and 6 position	Spare switch positions.

3. DESCRIPTION OF CHART SET

Chart Set, Calibration PT-320/URM-42 consists of six pages containing brief operating instructions and a family of calibration curves that are plotted for each individual equipment.

Page one provides summarized operating procedures together with instructions for the proper use of the calibration curves appearing on the succeeding pages. Bandwidth data for the individual equipment is entered at the bottom of page one of the Chart Set.

Before making a measurement on a given frequency, it is necessary to adjust the gain of the RI-FI meter unit by means of the CAL control so that the product of the indicating meter reading times the attenuator setting equals 100 microvolts when a signal of 100 microvolts is inserted at the input end of the 20-foot R-F transmission line. The calibration setting is derived from Charts #1 through #4 which contain a set of four curves

covering the calibration factors for use with either the six-foot or 20-foot R-F transmission line and each of the four R-F Tuners.

Chart #5 contains a curve for determining the small cone (AT-570/URM-42) antenna factor at any frequency throughout the range of 1.0 to 10.0 kmc/s. These factors, when multiplied by the meter reading in microvolts, result in the measured field intensity in microvolts-per-meter.

4. OPERATING INSTRUCTIONS

a. Introduction:

Instructions for connecting the various input devices are contained in Section 3, Installation. In the procedures given here, only a statement of the type of input device required will be given.

NOTE

THE WORD "SIGNAL" IS USED HERE TO DESIGNATE ANY R-F INPUT TO THE EQUIPMENT, I.E., SINE WAVE, RANDOM INTERFERENCE, OR PULSE INTERFERENCE.

The input devices comprise the two cone antennas and R-F Probe DT-56/URM-17. These units are all connected by means of the R-F transmission line (six foot or twenty foot) to Coaxial Switch SA-352/U.

b. Use of Antennas:

(1) Use of the Large Cone Antenna (AT-522/URM-42):

Use of the large cone antenna will generally be limited to the taking of approximate measurements of relatively weak signals within the 1.0 to 3.0 kmc/s band of frequencies. Under normal signal conditions, the small cone antenna is to be used, in conjunction with its calibration factors. The large cone antenna is provided with neither a directional shield assembly or calibration factors. Approximate large cone antenna factors can be derived by comparing readings taken with it and a given signal directly with the readings taken with the small cone antenna, for which antenna factors are provided.

(2) Use of the Small Cone Antenna (AT-570/URM-42):

The small cone antenna is used for field intensity and radio interference measurements; that is, for measuring the strength of the signal in microvolts-per-meter, and for determining the approximate magnetic bearing of the signal source. The small cone antenna can be used over the entire frequency range of the equipment and should be oriented for maximum response by adjusting for the type of polarization, angle of incidence, and azimuth bearing in order to obtain accurate measurements of field intensity.

The reception pattern of a cone antenna is such that while the antenna is omnidirectional in azimuth (with the ground plane horizontal), it has clearly defined maxima in elevation whose displacement angles, with respect to the ground plane, vary as a function of frequency. The pattern might be thought of as the covering of an inverted parasol whose degree of opening is controlled by the frequency of operation. The antenna provides maximum response to vertically polarized waves when the ground plane is parallel to the surface of the earth, while horizontally polarized waves are best received when the ground plane is at right angles to the earth's surface. Signals having mixed polarization can be received with the ground plane tilted to some angle between the vertical and horizontal. Due to the nature of the reception pattern, it can be seen that while the antenna is omnidirectional in azimuth when oriented for vertical polarization, it becomes a highly bi-directional device when oriented for horizontal polarization. In addition, it will be noted that when the antenna is oriented for horizontally polarized waves, the azimuth pointer indicates a magnetic bearing through the antenna ground plane which is not related to the bearing of the signal source. For example: assume the antenna is oriented for horizontal polarization and detects a maximum signal reading at an azimuth pointer bearing of 180 degrees. This might normally be interpreted to indicate the signal source bearing at either 180 or 0 (or 360) degrees. However, these bearings would be in error due to the parasol-like reception pattern discussed above. The method for resolving the true magnetic bearing can be found below. All of the foregoing conditions must be considered in orienting the antenna for maximum response when making field intensity measurements.

When it is desirable to ascertain the magnetic bearing of a signal or interference source, the polarization can be ignored and the antenna can be oriented with the ground plane parallel to the earth's surface. This is permissible because the antenna will respond to all types of polarization to some degree in this position and maximum intensity is unnecessary because the null method of azimuth determination is recommended, as follows:

After tuning the R-F Tuner to the frequency of the signal under measurement, secure the directional shield assembly to the antenna and rotate the antenna until an aural null is found. In the event that a double null is obtained, the true azimuth bearing is indicated by a point on the azimuth circle exactly midway on the smaller arc between the two azimuth nulls.

c. Adjusting Equipment for Standard Gain:

Accurate measurements can be made only after the equipment has been adjusted for standard gain. For best results, allow at least a 30-minute warmup period before proceeding with the following steps.

Step 1. Select the appropriate R-F Tuner. Install in position in the Case, Radio Interference

Measuring Set CY-1648/URM-42 and adjust the TUNE control for the desired frequency, as indicated by the frequency counter.

Step 2. Set the input coaxial switch to position 1.

Step 3. Rotate the Function Switch on the RI-FI meter unit to the PEAK position.

Step 4. Turn the CAL control to its maximum counterclockwise position.

Step 5. Refer to Charts #1 through #4 of the calibration chart set and determine the correct value of calibration voltage and the proper attenuator setting for standardizing the gain of the equipment at the desired frequency. This voltage is given in decibels.

Step 6. PULL the Attentuator knob out, TURN to the correct position as determined in step 5, and PUSH all the way in.

Step 7. Adjust the PEAK control until the indicating meter reads the correct voltage, as determined in step 5, on the decibel scale.

Step 8. Rotate the AUDIO control to its maximum clockwise position.

Step 9. Set the PULSE STRETCHER - OFF switch to the PULSE STRETCHER position.

Step 10. Turn the PULSE ON - OFF switch to its ON position.

Step 11. Plug a pair of headphones into one of the AUDIO OUTPUT receptacles and rotate the CAL control clockwise until pulses from the impulse noise generator are audible in the headphones, then adjust counterclockwise to a point where the pulses just become inaudible. Adjust the control back and forth to find exact threshold. The gain of the equipment is now standardized at this particular frequency. The CAL control setting should not be changed unless it becomes necessary to re-standardize gain at this frequency or it is desirable to change frequency, at which time the equipment gain must be standardized for the new frequency.

Step 12. Turn the PULSE ON - OFF switch to the OFF position.

d. Signal Measurement:

Step 1. Turn the Function Switch to the desired position.

NOTE

USE THE FIELD INTENSITY (FI) POSITION FOR SINE WAVE, CW, AMPLITUDE-MODULATED, OR FREQUENCY-MODULATED SIGNAL MEASUREMENTS. THE QUASI-PEAK (QP) POSITION IS USED IN RADIO INTERFERENCE AND PULSED SIGNAL MEASUREMENTS TO OBTAIN A "WEIGHTED" NEAR-PEAK READING. USE THE PEAK POSITION TO DETERMINE THE PEAK VALUE OF A RADIO INTERFERENCE OR PULSED SIGNAL AS SEEN BY THE SECOND DETECTOR OF THE RI-FI METER UNIT.

Step 2. Set the input coaxial switch to position 2 or 3 (corresponding to the six foot or 20 foot R-F transmission line).

NOTE

SPARE COAXIAL SWITCH POSITIONS ARE AVAILABLE FOR USE WITH FIELD FABRICATED ACCESSORY CABLES AND ACCESSORIES; HOWEVER, THE DATA CONTAINED IN CHART SET CALIBRATION PT-320/URM-42 IS TRUE ONLY FOR THE PARTICULAR R-F TRANSMISSION LINE SUPPLIED WITH THE EQUIPMENT.

Step 3. Using the PULL-TURN-PUSH sequence, get the Attenuator knob to the X10 position.

Step 4. Tune in the desired signal by means of the R-F Tuner tune control. Tune CW signals for maximum meter reading.

NOTE

THE SIGNAL MUST BE NEAR THE FREQUENCY AT WHICH THE EQUIPMENT WAS SET FOR STANDARD GAIN. OTHERWISE, IT WILL BE NECESSARY TO STANDARDIZE THE GAIN OF THE EQUIPMENT AT THE NEW FREQUENCY BEFORE AN ACCURATE MEASUREMENT CAN BE MADE.

Step 5. Adjust the position of the attenuator knob until the meter indicates a reading within the scale range, preferably in the upper portion of the scale.

Step 6. Read the indicating meter in microvolts. Compute the level of the measured signal as follows:

(1) As a two-terminal voltmeter, multiply the meter reading by the attenuator knob setting. (Example: assume attenuator setting of $X10^2$ and a meter indication of 25 microvolts; then, $25 \times 10^2 = 2,500$ microvolts across 50 ohms.)

(2) When the small cone antenna is used, multiply the meter reading in microvolts by the antenna factor from page 4 of the calibration chart set. Multiply this product by the attenuator setting. (Example: assume an Attenuator setting of X10 and a meter indication of 70 microvolts; the signal frequency is 6.6 kmc/s. From Chart #5 of the calibration chart set, we find that the antenna factor is 140. Then, $70 \times 10 \times 140 = 98,000$ microvolts-per-meter.)

e. Radio Interference Measurement:

When it is desired to measure the effective peak value of random or impulse interference, the PEAK, or slideback, function is used. First, standardize the gain of the equipment at the test frequency and then, proceed with the following steps:

Step 1. Set the input coaxial switch to position 2 or 3, depending upon whether the 20 foot or six foot R-F transmission line is used.

Step 2. Turn the function switch to its PEAK position.

Step 3. Set the PEAK control to its completely counterclockwise position.

Step 4. Adjust the position of the attenuator knob to the X10 position, using the PULL-TURN-PUSH sequence.

Step 5. Adjust the AUDIO control for a convenient aural level in the headphones.

Step 6. Slowly adjust the PEAK control clockwise until the headphone signal just becomes inaudible. If necessary, advance the AUDIO control to a high level to facilitate establishment of this threshold point. Do not advance the PEAK control beyond the point of inaudibility or an erroneous meter indication will result.

Step 7. Observe the meter as the point of inaudibility is approached. If the meter goes off scale, advance the Attenuator knob to the next higher attenuation step and return the PEAK control to its fully counterclockwise position. Then repeat the adjustment of the PEAK and AUDIO controls to determine the actual threshold point of inaudibility.

NOTE

TAKE INTO ACCOUNT THE SLIGHT LAG IN THE EFFECT OF THE PEAK CONTROL.

Step 8. Read the indicating meter. The reading is equivalent to a bias voltage (introduced by the PEAK control) that is identical to the peak value of the input signal as seen by the second detector of the RI-FI meter unit.

Step 9. Compute the effective peak value of the measured signal by applying the Attenuator factor (and the antenna factor from page 4 of the calibration chart set if the small cone antenna is used). (Example 1: assume the use of R-F Probe DT-56/URM-17, Attenuator knob setting of $X10^2$, a frequency of 3.0 kmc/s, and a meter indication of 60 microvolts. Then:

$60 \times 10^2 = 6,000$ microvolts across 50 ohms.)

NOTE

THIS VALUE MUST BE CONSIDERED APPROXIMATE SINCE THE INSERTION LOSSES OF THE R-F PROBE HAVE BEEN IGNORED. THE INSERTION LOSSES FOR THE PROBE CAN BE MEASURED AT SELECTED FREQUENCIES, IF DESIRED, AND CORRECTION FACTORS DERIVED WHICH WILL PERMIT ACCURATE MEASUREMENTS TO BE MADE WITH THIS INPUT DEVICE.

(Example 2: assume that the small cone antenna is in use, a frequency of 1.0 kmc/s, an attenuator setting of $X10^3$, and a meter indication of 16 microvolts. From page 4 of the calibration chart set, we find the antenna factor is equal to 40. Then: $16 \times 40 \times 10^3 = 640,000$ microvolts-per-meter.)

It may be observed that a difference in meter indication can exist between two RI-FI Meters in the same location, measuring the same noise signal. It is the purpose of the immediately following paragraphs to explain and provide correction factors for this effect.

Variations in the "Q" of tuned circuits, in tube loading, in individual electron tube characteristics, and slight tracking differences are normally present in all equipments of this type. For this reason, variations in the overall bandpass from one equipment to another will be noted.

This problem can be resolved by converting the meter reading into microvolts-per-megacycle bandwidth data as a two-terminal voltmeter or by converting into microvolts-per-meter-per-megacycle bandwidth data as a field intensity meter. To derive microvolts-per-kilocycle values, divide the microvolts-per-megacycle values by 1000.

If the bandpass is other than one megacycle, then the conversion factor (K), by which the meter reading is to be multiplied, will depend upon the type of signal and the bandwidth, as shown below.

(1) In the case of a sine wave signal, the peak, average, and effective voltages are independent of bandwidth. The factor, applicable to readings taken in the field intensity (FI), quasi-peak (QP), and PEAK Function Switch positions is, therefore:

$$K = 1$$

(2) For a noise of predominantly random nature, the peak and average voltages are proportional to the square root of the effective random noise bandwidth. The conversion factor, also applicable to readings taken in the FI, QP, and PEAK Function Switch positions, is:

$$K_{RN} = \frac{1 \text{ mc/s}}{\sqrt{\text{Effective random noise bandwidth in mc/s}}}$$

(3) When the noise signals are predominantly impulsive, the PEAK value of the voltage is directly proportional to the effective impulse noise bandwidth. The conversion factor given below, therefore, is applicable only to readings taken in the PEAK Function Switch position:

$$K_{IN} = \frac{1 \text{ mc/s}}{\sqrt{\text{Effective impulse noise bandwidth in mc/s}}}$$

Average and quasi-peak readings of impulse signals are also influenced by pulse repetition frequency, pulse width, charge time of the weighting circuits, and the overload factor. For this

reason, a definite conversion factor cannot be supplied.

The following chart will enable the operator to determine the proper detector functions and multiplication factors for use in making various types of measurements.

Table 4-2, Noise Plus Signal Chart

TYPE NOISE (1)	TYPE SIGNAL (2)	DETECTOR FUNCTION	ADD DIRECT	ADD RMS*
Random	Sine Wave	Field Intensity Quasi-Peak	X	X
Random	Random	Field Intensity Quasi-Peak		X X
Random	Impulse High Repetition	Field Intensity Quasi-Peak	X	X

Note: Internal noise is of a random nature.
*RMS = Root Mean Square, e.g.,

$$\sqrt{(\text{signal (1)})^2 + (\text{signal (2)})^2}$$

The effective random noise bandwidth and effective impulse noise bandwidth data is provided at the bottom of page 1 of the calibration chart set.

(Example 1: determine the signal strength in microvolts-per-meter-per-megacycle when the RI-FI equipment, used as a field intensity meter, indicates 3000 microvolts-per-meter, the noise signal is predominantly impulsive, and the effective impulse noise bandwidth is 1.52 mc/s:

$$K = \frac{1 \text{ mc/s}}{1.52} = .658$$

3000 x .658 = 1,974 microvolts/meter/mc.)

(Example 2: determine the signal strength in microvolts-per-megacycle when the RI-FI equipment, used as a two-terminal voltmeter, indicates 1500 microvolts, the noise signal is predominantly random, and the effective random noise bandwidth is 1.07 mc/s:

$$K = \frac{1 \text{ mc/s}}{\sqrt{1.07}} = \frac{1}{1.0344} = .967$$

1500 x .967 = 1,450 microvolts/mc.)

f. Sine Wave Measurement in the Presence of High Ambient and/or Internal Noise Interference:

When a sine wave signal is being measured in the presence of high ambient interference or internal noise of random nature, it is possible to correct for the interference and determine the actual intensity of the signal as though the random interference were not present. Obtain the value of interference and signal combined and the value of "noise only." The "noise only" figure may be obtained by turning off the signal, if possible, or detuning slightly. Monitor with the headphones to determine how far to detune. When using the QP function, subtract the value of "noise only" directly from the value of interference and signal combined. When using the FI function, proceed as follows:

Step 1. Standardize the gain of the equipment for the frequency of the incoming signal as outlined in paragraph 4c of this section.

Step 2. Set the function switch to the FI function.

Step 3. Set the input coaxial switch to position 2.

Step 4. Measure the intensity of the random interference in the absence of signal as outlined in paragraph 4e of this section. If necessary, detune slightly off the signal.

Step 5. Tune in the signal and measure the value of interference and signal combined as outlined in paragraph 4d of this section.

Step 6. The value of the signal in the absence of interference can then be computed by the formula:

$$\text{Signal} = \sqrt{(\text{Signal} + \text{noise})^2 - (\text{Noise})^2}$$

5. USE AS A SENSITIVE RADIO-FREQUENCY MICROVOLTMETER

Radio Interference Measuring Set AN/URM-42 is a highly sensitive selective two terminal voltmeter. By considering the applications carefully, it can be used as follows:

a. As a null instrument in conjunction with r-f bridges suitable for operation in the 1.0 to 10.75 kmc/s band of frequencies. Extremely short leads, preferably shielded, must be used and extreme care must be taken to assure proper impedance matches.

b. To measure the gain of a radio-frequency stage in radio equipment by measuring the signal input to the stage and the signal output from the stage. The R-F Probe DT-56/URM-17 must be used and it should be noted that this device shunts approximately 50 ohms across the circuit and may upset the stage under test.

c. To check the voltage on any 50-ohm transmission line up to 10 volts, provided the transmission line is properly terminated. R-F Probe DT-56/URM-17, rated at 1000 volts ac peak, is used for transmission lines of this impedance. These measurements must not be considered as accurate, however, due to the errors introduced by insertion losses of the probe. No correction chart is supplied with this probe because of

individual and erratic resonances that occur. Reliable correction factors can, however, be derived at selected frequencies by operating activities and these factors can be applied to measured data for improved accuracy. Voltages in other low-impedance lines can also be measured; however, these measurements will be only approximations due to the errors introduced by the mismatch.

d. To determine the loss in a coaxial line connected to a signal generator by comparing the signal level at the input and output ends of the line. An appropriate impedance matching network must be fabricated for insertion between the line and the input of Radio Interference Measuring Set AN/URM-42.

6. SURVEY CONSIDERATIONS

a. Field Intensity Considerations:

A knowledge of the fundamentals of wave propagation is essential in order to properly conduct field intensity surveys. The study of wave propagations is highly complicated by the large number of variable factors that must be considered and by the interpretation of the results of a series of measurements. This section of the instruction book contains a brief description of some of these factors as they apply to the frequency range covered by Radio Interference Measuring Set AN/URM-42.

(1) Selecting the Site for Field Intensity Measurements:

It is sometimes necessary to make field intensity measurements at a designated location, and it is then essential to consider the effect of surrounding objects on the received signal strength. Often, however, the measurement location can be selected, and the observer must then know what constitutes a good site for a given set of conditions. Measurements should be made at distances greater than two wavelengths from the transmitter in order to avoid the influence of the induction field.

In selecting a site for field intensity measurements, the following considerations should be kept in mind: The radio-frequency voltage induced in a receiving antenna is proportional to the intensity of the electromagnetic field in the space occupied by the antenna. The intensity at this point will depend upon the radiated power, the frequency of the received signal, the distance from the transmitter, the attenuation over the path between the transmitter and receiver, reflections and reradiations from nearby conductors, such as power lines, wire fences and steel buildings, absorption by trees, and the effects of hills, gullies, or cliffs.

The ideal site would be an open, flat terrain at a considerable distance (1000 feet or more) from buildings, electric lines, fences, etc. Ideal sites are rare in the more populated sections of the country and, therefore, it is good practice to check a proposed location by making measurements of the desired signal at several points in the vicinity. If the same value of field intensity is obtained at each of the points, any one of the sites can be considered satisfactory. If it is necessary to use an unsatisfactory site, a series of readings should be recorded at a number of different points in the neighborhood of the selected site, and detailed notes on the site conditions should be appended to the recorded data.

There are no fixed rules to govern the minimum distance between the field intensity measuring equipment and the nearest wire lines or other disturbing objects because possible resonances are unpredictable. Another consideration in site selection is the possible presence of local electrical interference sources which may make field intensity measurements difficult.

If measurements are to be made with the equipment mounted in a vehicle, it will be necessary to determine the effect of the vehicle on the received signal. This is done by measuring the signal with the equipment mounted in the vehicle as it is to be used and again with it temporarily located some distance away from the vehicle. If differences are noted, measurements should be taken with the vehicle heading changed 15 or 20 degrees at a time. The differences between the readings taken in the vehicle and those taken outside the vehicle are then plotted in percentages of the outside readings versus heading. A different curve will generally be needed for each operating frequency. A calibration of this type is facilitated by simultaneously using two similar equipments, one equipment set up in the open, and the other mounted in the vehicle and operated 50 to 75 feet away from the former.

(2) Propagation of Ultra-High and Super-High Frequencies:

Propagation of ultra-high and super-high frequencies is similar to propagation of light waves in that the transmission is line-of-sight and is affected by reflection and refraction. In general, the receiving antenna must be in an unobstructed line with the transmitting antenna.

If a transmission path lies near a reflecting surface, the energy picked up by the receiving antenna is made up of two components, one received directly from the transmitting antenna and the second reflected from the earth. The resultant of the direct and the reflected wave will depend not only on the difference in the length of the two paths but upon changes in phase or intensity introduced in the process of reflection. These phase or intensity changes result in breaking up the transmitted energy pattern into a lobe structure (not to be confused with polar plot of antenna directional characteristics). The longer the

wavelength, the higher the lowest lobe is tilted upward from the surface of the earth. Hence, the energy received in an aircraft will be determined by its position relative to the maximum and minimum points of the lobe structure.

Transmission in these frequencies is affected by refraction, the refraction resulting from vertical temperature gradients. For example, when land is heated by the sun and cools by radiation at night, a thin layer of dense cool air is formed just above the ground, resulting in a rapid decrease of refractive index with height. Refraction causes the transmitted wave to bend slightly in conformation with the contour of the earth.

A more widespread cause of strong vertical gradients in refraction index, and therefore of excessive bending of transmitted energy, is the refractive effect of water vapor. Over most of the surface of the ocean the region above the water is not saturated with water vapor, whereas the layer in direct contact with the water must be very nearly saturated. There is a continual evaporation of water from the sea and a diffusion of the vapor upward into the overlying airmass. Thus, there exists a vertical gradient in the concentration of water vapor with the highest concentration at the surface and decreasing upward. This tends to form a duct in which the transmitted wave curves to follow a direct path as if it were enclosed in a huge waveguide.

The average or standard refraction effect of the atmosphere can be taken into account by assuming that the earth has a radius 4/3 times its actual value, and by computing geometrical horizon ranges on this assumption. When this is done, the horizon will be at a distance $\underline{r}$ from a point $\underline{h}$ above a spherical earth given by:

$$\underline{r} = 1.22\sqrt{\underline{h}}$$

where $\underline{h}$ is in feet and $\underline{r}$ is in nautical miles; or by:

$$R = \sqrt{2\underline{h}}$$

where R is in land miles and $\underline{h}$ is in feet.

The radio horizon distance between a point of $\underline{h_1}$ and another at height $\underline{h_2}$ is:

$$r = 1.22\sqrt{h_1} = 1.22\sqrt{h_2}$$

The importance of antenna elevation for line-of-sight transmissions in this frequency band are emphasized by the square root dependence in the above formulae.

(3) Recording of Observed Data:

In addition to correct operating procedures described elsewhere in this instruction book, it is essential that data records be very complete so that the results of a survey can be properly interpreted and evaluated by interested personnel.

When graphic records are made, each recorder chart must be carefully identified and complete information supplied for each series of measurements. This information should include the date, start and finish time, the test identification, the location (very carefully described as to geographical position and to presence of disturbing objects), description of weather conditions, the equipment used, the measurement frequency, the calibration, the attenuator setting, the function switch position, the antenna used, the chart speed, erratic conditions the non-opposite minima. A convenient form for entering data on a recorder chart is contained in Table 4-3.

When graphic recording is not employed, the same information should be entered on a form such as that shown in table 4-4. Some of the data may appear to be superfluous at the time of observation, but it is often invaluable when trying to interpret results at a later date. A separate record sheet or graphic record chart should be used for each measurement location.

A sample description of a measurement site is as follows:

Site No. 9 - 15.7 miles north of Riverside, California State Route 498 (0.4 miles south of intersection with State Route 37), 450 feet east of highway in open field; grove of trees approx. 50 feet high lies 500 feet northeast of site; nearest wire lines 450 feet east, running north and south; nearest wire fence 300 feet south running east and west; terrain slightly rolling; check showed uniform field conditions.

In the "Remarks" column of the data sheet, enter all pertinent information such as height of antenna, weather and atmospheric conditions, poor minima, local interference, fluctuations in signal strength, operational difficulties, and any other data that may be useful.

The observed field intensity can be measured and listed in either microvolts-per-meter or in decibels above one microvolt-per-meter. It is sometimes desirable, however, to be able to convert from one to the other. The following formula may be used for this purpose:

FI decibels above one microvolt/m(db) = 20 X $\log_{10}$FI(microvolt/m).

b. Radio Interference Considerations:

(1) Selecting the Site for General Interference Surveys:

An open flat terrain is preferred to preclude absorption by dense growths of trees and steep ridges. Also, the face of a nearby cliff may act as a reflector and produce local variation in the intensity of interference measured.

Table 4-3, Graphic Recorder Chart

Date.....

TEST.....

LOCATION.....

.....

(use additional space for complete description).....

Equipment.....Ser. No.....

Freq.....Calibration.....

Atten. Setting.....Function Sw.....

Antenna.....

Height above ground.....

Ground.....

Recorder Ser. No.....Chart Speed.....

Time: Start.....Stop.....

Observers.....

Notes.....

.....

In general, interference surveys made in the vicinity of power lines are subject to inaccurate results because of possible reradiation from the power lines and it is necessary to measure at a considerable distance from these lines.

Every attempt should be made to avoid locating the equipment near closed loops present in iron-framed buildings and topside structures aboard ship. If possible, avoid locations in the vicinity of underground pipes, trolley cables, or rail lines.

When the equipment is installed in a vehicle, it should be remembered that the metal body and frame of the vehicle tend to distort the pickup pattern of the antenna. In addition, closed loops formed by vehicle wiring or structural members will affect the field pattern. In some cases, these errors can be determined with the equipment mounted in a designated location. Correction factors so obtained may then be applied to compensate for pickup pattern distortion.

When a variety of equipment, including radio receivers, is employed at any one site, check for interaction.

Choose at least three sites not in a line for radio interference surveys, since triangulation is used to locate the source of interference.

NOTE

SURVEY RESULTS MUST BE EVALUATED ACCORDING TO HOW CLOSE ACTUAL SURVEY SITES APPROACH IDEAL CONDITIONS.

(2) Interference Survey:

An interference survey of a suspected area should begin with a series of measurements, at the frequencies under investigation, made with the small cone antenna and directional shield assembly. Should a station or service be found operating on the frequency selected for measurement, move sufficiently away in frequency to avoid side bands of the station. The survey report should, however, note the frequency and field intensity of signals from the station.

During the survey the received signals should be aurally monitored at a volume level that will enable identification of the received signal or interference.

Three-point fixes on each source of interference

Table 4-4, Field Intensity — Radio Interference Data Record Chart

Date..... Interference source of transmitting station.....

Radio Interference Measuring
Set AN/URM-42, Ser. No..... Meas. Site.....

(On back of this sheet, list all pertinent site data as suggested in paragraph 7a(3).)

Observers.....

..... Distance from trans.....naut. mi.....stat. mi.....

.....

.....

1	2	3	4	5	6	7		8
Time	Freq.	Ind. μv	Att. Set.	Corr. Fact	Pickup	FI		REMARKS
						μv/m	db	

Notes: (1) Cross out FIELD INTENSITY or RADIO INTERFERENCE in data sheet heading, also location of source, whichever does not apply to data recorded.

(2) Col. 3 is indicated microvolts on Radio Int. Meas. Set AN/URM-42.
Col. 4 is attenuator setting of Radio Int. Meas. Set AN/URM-42.
Col. 5 is correction factor of Radio Int. Meas. Set AN/URM-42.
Col. 6 is the type of antenna or other pickup device.
Col. 7 is the resultant field intensity.
(v/m = Col. 3 X Col. 4 X Col. 5)
(db = 20 X $\log_{10}$ (μv/m))
Col. 8 is for notes on weather conditions, operational difficulties, height of transmitting and receiving antennas, etc.

(3) Be certain to fill in sheet numbers at right hand corner to maintain continuity of sheets.

enable the geographic location to be determined by triangulation, using magnetic bearings. The next step is to investigate each interference source in turn, moving the RI-FI meter close to each source of interference and refining the distant fix previously obtained.

If the interference source is found to be a power line or other current-carrying conductor, substitute R-F Probe DT-56/URM-17 for the antenna and use the equipment as a two-terminal voltmeter to determine the approximate amount of conducted interference on the line.

WARNING

STANDARD SAFETY PRECAUTIONS SHOULD BE TAKEN WHEN CONNECTING TO POWER LINES OR ANY EQUIPMENT WHICH MAY BE ENERGIZED FROM A SWITCH NOT UNDER THE CONTROL OF THE OPERATOR OF RADIO INTERFERENCE MEASURING SET AN/URM-42. CONNECTIONS SHALL BE MADE WITH THE POWER REMOVED FROM THE LINES OR EQUIPMENT.

(3) Recording of Observed Data:

The data form is shown in Table 4-4. (See note 1 of the table). Record on the back of the data sheet interference reduction measures taken, if any. Check the effectiveness of interference reduction measures taken by comparison measurements.

SECTION 5

MAINTENANCE

1. INTRODUCTION

The procedures and tables of this section are for the purpose of assisting maintenance personnel in the repair and adjustment of Radio Interference Measuring Set AN/URM-42. When the equipment has failed in operation, the source of trouble must be located, the defect remedied, and the equipment restored to operation. The information is, therefore, presented in the following order:

Localization of Trouble (par. 2)
Removal of Chassis from Instrument Cases (par. 3)
Troubleshooting Procedures (par. 4)
Maintenance Procedures (par. 5 through 9)

NOTE

MAINTENANCE PERSONNEL MUST FILL OUT A FAILURE REPORT FOR EACH PART, COMPONENT, TUBE, OR MECHANICAL ASSEMBLY REPAIRED OR REPLACED.

2. LOCALIZATION OF TROUBLE

Troubleshooting problems in Radio Interference Measuring Set AN/URM-42 can be located just as troubles are located in communications receivers. Inspect the entire equipment in an attempt to isolate the faulty unit. Check the interconnecting cables between units. Determine that required input power is applied to the two power supplies and impulse noise generator and that operating potential outputs of the two power supplies are delivered to the R-F Tuner and the RI-FI meter and are at the proper levels. Determine whether or not an output indication can be obtained on a remote meter. Check that panel operating controls are properly employed as described in Section 4, Operation.

If one of the r-f input devices is the source of trouble, check the continuity of the circuit through the suspected device.

When apparent lack of operating potential output from either power supply is noted, check by making measurements at the output receptacle of the defective unit.

When malfunctioning has been localized to a particular unit, continue the elimination procedure with the aim of locating the faulty stage. It should be kept in mind that the overall equipment is similar to a communications receiver, having an r-f section (R-F Tuner), i-f section, and a-f section (RI-FI meter). In addition, it has a calibrator (impulse noise generator), an attenuator, a VTVM circuit, and detector weighing circuits (RI-RI meter). The impulse noise generator constitutes a convenient signal generator for checking receiver operation and aiding in signal tracing procedures.

One major source of improper equipment operation is incorrect calibration and alignment control adjustment. Complete calibration and alignment procedures are contained in this section to aid in bringing the equipment up to highest sensitivity and accurate calibration.

Detail troubleshooting procedures for the four R-F Tuners can be found in the appropriate instruction book: AN 16-30APR9-12.

3. REMOVAL OF CHASSIS FROM INSTRUMENT CASES

a. General:

After localizing the trouble source within a particular major unit, remove the suspect chassis from its case and trace the trouble to the faulty component or components. The following subparagraphs contain instructions for removing each of the major chassis from its enclosure.

b. R-F Tuners:

Instructions for removal of R-F Tuners TN-128A/APR-9, TN-129C/APR-9, TN-130A/APR-9, and TN-131B/APR-9 from their individual instrument cases are contained in the Handbook of Overhaul Instructions for Radar Set AN/APR-9, -9A, -9B: AN 16-30APR9-13.

c. R-F Tuner Power Supply:

The R-F tuner Power Supply PP-1179/URM-42 is not installed in an instrument case but, rather, is provided with a protective metal cover and a separate bottom plate. To remove the covers from the unit, remove the four screws securing the mounting board within the power supply case, slide the mounting board out of the case, and remove the six screws securing the power supply to the board. Remove the four screws, two at each end, securing the protective cover to the chassis, and lift off the cover. To remove the bottom plate, remove the four screws securing the plate to the chassis and lift off the plate.

d. RI-FI Meter:

To remove the RI-FI meter from its case, remove the four screws securing the cable holder mounting board within the case and, lifting from the front of the board, remove the cable holder

and mounting board from the case. Remove the four rubber feet on the back of the RI-FI meter instrument case and slide the chassis from the case. Be careful that the impulse noise generator and input coaxial switch, mounted to the top of the RI-FI meter instrument case, are not damaged in this procedure.

e. RI-FI Meter Power Supply:

In order to remove the RI-FI meter power supply from its instrument case, first remove the four screws securing the mounting board within the Power Supply Case, then slide the board from the case and remove the four screws securing the RI-FI meter power supply to the mounting board. Stand the power supply on its front panel guards, remove the ten screws at the sides of the chassis, and slide the case off the chassis. To gain access to the under-chassis components, lay the chassis on one side so that the front panel is accessible. Remove the fourteen screws at the edges of the front panel and lift the panel away to the extent permitted by the wiring between panel and chassis.

The following procedure must be followed in order to properly seal the power supply when replacing the chassis in the instrument case. Stand the power supply on the front panel guards. Slide the case over the chassis and start the ten screws in the sides of the case. Invert the power supply so that the panel is up. Start the fourteen screws at the edges of the front panel. First tighten the ten screws at the sides of the case, then tighten the fourteen screws on the front panel.

f. Impulse Noise Generator:

To remove Generator, Interference SG-112/URM chassis from its instrument case, remove the seven screws at the sides and top of the case, and slide the chassis from the case. To gain access to the under-chassis components, lay the chassis on one side so that the front panel is accessible. Remove the fourteen screws at the edges of the front panel, loosen the set screw securing the PULSE ON-OFF knob to its shaft and remove the knob, and lift the panel away to the extent permitted by the wiring between chassis and panel.

The following procedure must be followed in order to properly seal the unit when replacing the chassis in the instrument case. Slide the chassis into the case and start the seven screws in the sides and top of the case. Start the fourteen screws at the edges of the front panel. First tighten the seven screws at the sides of the case, then, tighten the fourteen screws on the front panel. Replace the PULSE ON-OFF knob on its shaft and secure in the proper position by tightening the knob set screw.

4. TROUBLESHOOTING AND REPAIR

NOTE

FOR TROUBLESHOOTING AND REPAIR OF R-F TUNERS TN-128A/APR-9, TN-129C/APR-9, TN-130A/APR-9, AND TN-131B/APR-9, REFER TO THE PERTINENT INSTRUCTION BOOK: HANDBOOK OF SERVICE INSTRUCTIONS FOR RADAR SET AN/APR-9,-9A,-9B: AN 16-30APR9-12.

a. General:

Instructions contained in this paragraph are designed to determine the cause of equipment failure, correct the cause of malfunctioning, and return the equipment to normal operation. Special precautions must be taken when working within the instrument cases since dangerous potentials, as great as 2650 volts, are present within the R-F Tuners and R-F tuner power supply.

b. Tube Changes:

In order to avoid any possible upset of equipment alignment and calibration, avoid interchanging vacuum tubes, and replace tubes only when a sensitivity test indicates this need. Wherever possible, miniature tubes are used throughout the equipment. These miniature tubes are held in place by spring-loaded tube shields. To remove a miniature tube, depress and turn its tube shield counterclockwise, then lift. Grasp the tube with two fingers and pull straight out of the socket. Straighten bent tube pins, using a pin straightener, before inserting any miniature tube into a socket.

In removing the tube shield on V109 in the RI-FI Meter, observe the aluminum washer placed between the top of the tube and the tube shield. This washer is required to maintain a fixed capacitance between the tube shield and the tube elements. Place the washer over V109 before putting the tube shield in place. In the event the washer has been lost, obtain a replacement with the following dimensions: 51/64 OD x 0.144 ID x 1/32 in. thick.

Voltage regulator V303 in the RI-FI meter power supply has a bayonet base. When replacing the tube in its socket, it should be inserted so that the central cylinder supports the glow. If the spiral wire supports the glow, remove the tube, rotate it 180 degrees, and replace it in the socket.

c. Fuse Changes:

All fuses in the equipment are accessible from the front panel of the unit they protect. Fuses must never be replaced with fuses having ratings greater than those employed in the equipment. Fuses having lower ratings can be utilized, under emergency conditions, as replacements, but must be replaced at the first opportunity with fuses having the proper ratings.

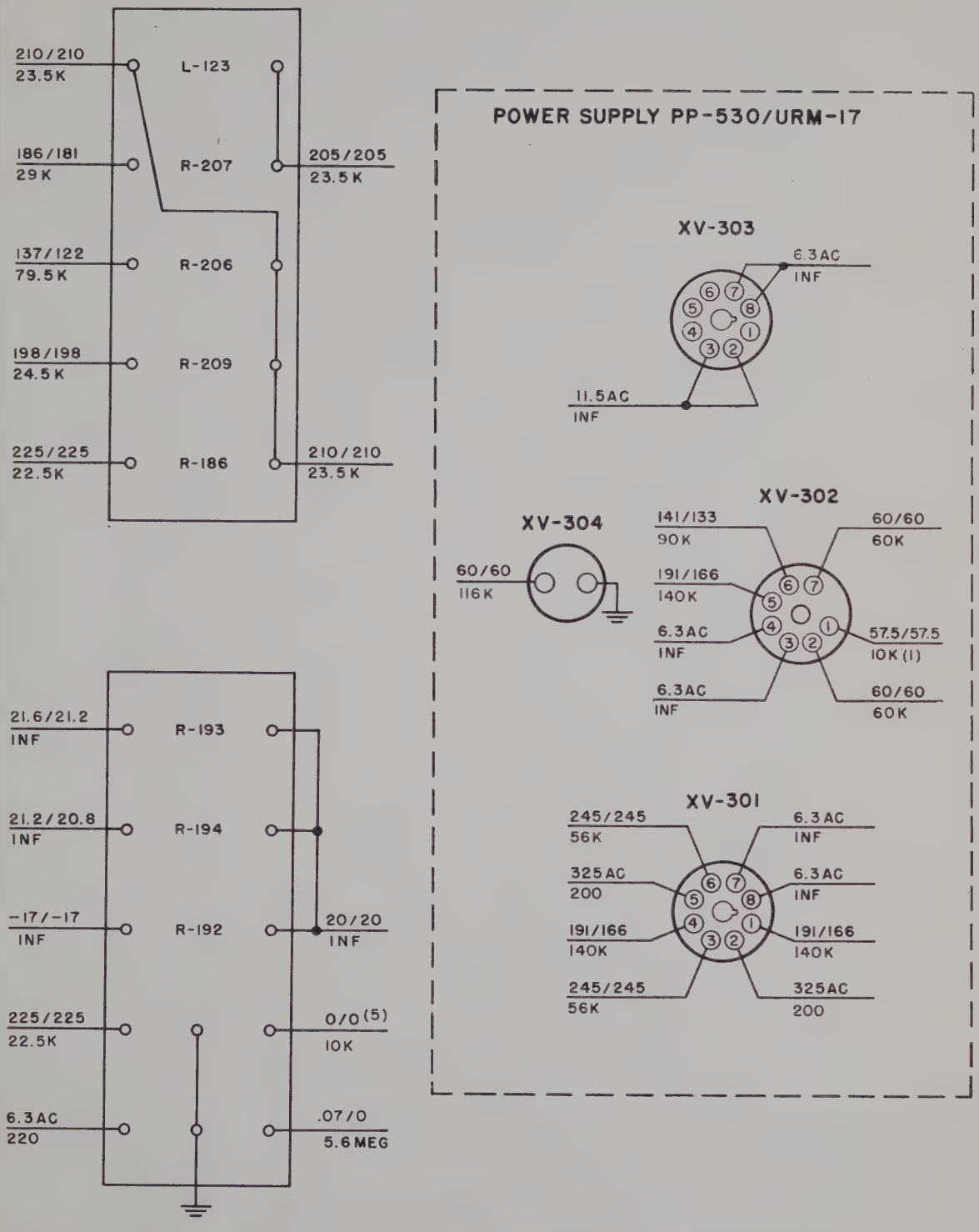


Figure 5-1, Meter, Radio Frequency Interference, IM-103/URM-42, Voltage and Resistance Data

and mounting board from the case. Remove the four rubber feet on the back of the RI-FI meter instrument case and slide the chassis from the case. Be careful that the impulse noise generator and input coaxial switch, mounted to the top of the RI-FI meter instrument case, are not damaged in this procedure.

e. RI-FI Meter Power Supply:

In order to remove the RI-FI meter power supply from its instrument case, first remove the four screws securing the mounting board within the Power Supply Case, then slide the board from the case and remove the four screws securing the RI-FI meter power supply to the mounting board. Stand the power supply on its front panel guards, remove the ten screws at the sides of the chassis, and slide the case off the chassis. To gain access to the under-chassis components, lay the chassis on one side so that the front panel is accessible. Remove the fourteen screws at the edges of the front panel and lift the panel away to the extent permitted by the wiring between panel and chassis.

The following procedure must be followed in order to properly seal the power supply when replacing the chassis in the instrument case. Stand the power supply on the front panel guards. Slide the case over the chassis and start the ten screws in the sides of the case. Invert the power supply so that the panel is up. Start the fourteen screws at the edges of the front panel. First tighten the ten screws at the sides of the case, then tighten the fourteen screws on the front panel.

f. Impulse Noise Generator:

To remove Generator, Interference SG-112/URM chassis from its instrument case, remove the seven screws at the sides and top of the case, and slide the chassis from the case. To gain access to the under-chassis components, lay the chassis on one side so that the front panel is accessible. Remove the fourteen screws at the edges of the front panel, loosen the set screw securing the PULSE ON-OFF knob to its shaft and remove the knob, and lift the panel away to the extent permitted by the wiring between chassis and panel.

The following procedure must be followed in order to properly seal the unit when replacing the chassis in the instrument case. Slide the chassis into the case and start the seven screws in the sides and top of the case. Start the fourteen screws at the edges of the front panel. First tighten the seven screws at the sides of the case, then, tighten the fourteen screws on the front panel. Replace the PULSE ON-OFF knob on its shaft and secure in the proper position by tightening the knob set screw.

4. TROUBLESHOOTING AND REPAIR

NOTE

FOR TROUBLESHOOTING AND REPAIR OF R-F TUNERS TN-128A/APR-9, TN-129C/APR-9, TN-130A/APR-9, AND TN-131B/APR-9, REFER TO THE PERTINENT INSTRUCTION BOOK: HANDBOOK OF SERVICE INSTRUCTIONS FOR RADAR SET AN/APR-9,-9A,-9B: AN 16-30APR9-12.

a. General:

Instructions contained in this paragraph are designed to determine the cause of equipment failure, correct the cause of malfunctioning, and return the equipment to normal operation. Special precautions must be taken when working within the instrument cases since dangerous potentials, as great as 2650 volts, are present within the R-F Tuners and R-F tuner power supply.

b. Tube Changes:

In order to avoid any possible upset of equipment alignment and calibration, avoid interchanging vacuum tubes, and replace tubes only when a sensitivity test indicates this need. Wherever possible, miniature tubes are used throughout the equipment. These miniature tubes are held in place by spring-loaded tube shields. To remove a miniature tube, depress and turn its tube shield counterclockwise, then lift. Grasp the tube with two fingers and pull straight out of the socket. Straighten bent tube pins, using a pin straightener, before inserting any miniature tube into a socket.

In removing the tube shield on V109 in the RI-FI Meter, observe the aluminum washer placed between the top of the tube and the tube shield. This washer is required to maintain a fixed capacitance between the tube shield and the tube elements. Place the washer over V109 before putting the tube shield in place. In the event the washer has been lost, obtain a replacement with the following dimensions: 51/64 OD x 0.144 ID x 1/32 in. thick.

Voltage regulator V303 in the RI-FI meter power supply has a bayonet base. When replacing the tube in its socket, it should be inserted so that the central cylinder supports the glow. If the spiral wire supports the glow, remove the tube, rotate it 180 degrees, and replace it in the socket.

c. Fuse Changes:

All fuses in the equipment are accessible from the front panel of the unit they protect. Fuses must never be replaced with fuses having ratings greater than those employed in the equipment. Fuses having lower ratings can be utilized, under emergency conditions, as replacements, but must be replaced at the first opportunity with fuses having the proper ratings.

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AN/URM-42

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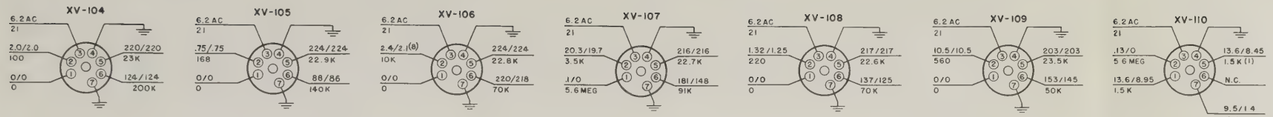
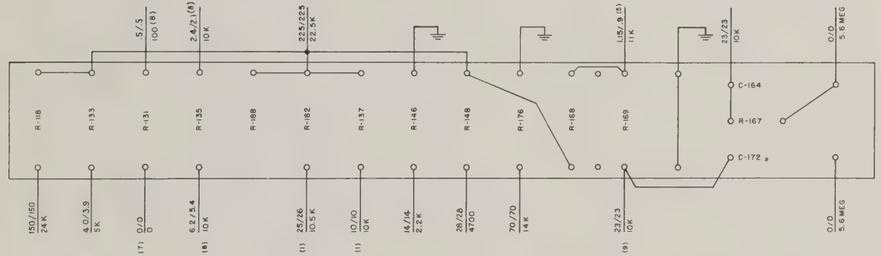
AN/URM-42

NAVSHIPS 92363
AN/URM-42



METER, RADIO FREQUENCY INTERFERENCE IM-103/URM-42



NOTES

(1) Depends on settings of under chassis controls. Do not change control settings except in alignment and calibration procedures.

(2) Plate volts taken at input filter at junction of R-118 and C-108.

(3) Function switch to ADJ position when measuring diode cathode or calibrator plate, ADJ control R-183 should be set for meter reading of 10 microvolts. Plate voltage of calibrator is taken at output of filter C-115; plate of diode at C-126.

(4) With Function Switch in FI. In CAL position reading of 42.5 K ohms to ground is obtained.

(5) Readings taken from circuit ground. Attenuator in X10 position unless otherwise specified.

(6) Local oscillator plate voltage should be taken with Frequency Dial set to approximately 400 mc.

(7) No voltage from R-131 to ground. Zero resistance in CAL or X10 position of RF attenuator.

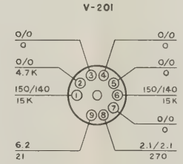
(8) Depends on Front Panel control settings.

(9) Noise set at one microvolt.

(10) With Function Switch in CAL or ADJ position, 58 volts.

CONDITIONS OF MEASUREMENT

1. All measurements are made from point shown to chassis except where otherwise indicated.
2. All voltage measurements are made with both 20,000 and 1,000 ohm/volt meters. The 20,000 ohm/volt reading is given first, followed by the 1,000 ohm/volt reading.
3. Readings followed by "A.C." were obtained with a 1,000 ohm/volt A.C. voltmeter.
4. All resistance measurements made with units disconnected and all tubes and pilot lights removed, also all front panel pots fully counter clockwise unless otherwise specified.
5. Measurements made with Function Switch on FI, Pulse Stretcher on OFF and Attenuator in X^{10} position unless otherwise specified.



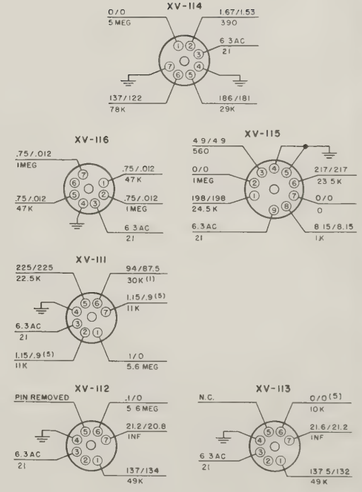


Figure 5-1, Meter, Radio Frequency Interference, IM-103/URM-42, Voltage and Resistance Data

Table 5-1, Tube Voltages

All voltages measured with a 20,000 ohm-per-volt voltmeter.

Power Supply PP-1179/URM-42

Tube		Pin No.	Voltage
V-401	OA2WA	1 & 5	0.0
		2, 4 & 7	-150
V-402	6AU6WA	1	-150
		2 & 7	-150
		3 to 4	6.3 AC
		5	-137
		6	- 7
V-403	6B4G	2 to 7	6.3 AC
		3	590
			350 AC
		5	-137
V-404	3B24W	1, 2 & 4	550
			1200 AC
		3 NC	
		Cap	-680
V405	3B24W	1, 2 & 4	550
			1200 AC
		3 NC	
		Cap	-680
V-406	6AU6WA	1	0.0
		2 & 7	0.0
		3 to 4	6.3 AC
		5	.5
		6	25
V-407	6080WA	1 & 4	.5
		2 & 5	350
		3 & 6	150
		7 to 8	6.3 AC
V-408	5R4WGB	2 to 8	5.0 AC
		2 to Gnd (2)	360
		6	348 AC
		4	345 AC
V-409	5933WA	1	6.3 AC
		4 & 5	0.0
		2	210
			420 AC
		3	- 55
		Cap	780
			1700AC
V-410	6AU6WA	1	-145
		2 & 7	-260
		3	0.0
		4	6.3 AC
		5	- 55
		6	- 3
V-411	3B24W	1, 2 & 4	-445
			640 AC
		3 NC	
		Cap (1)	-1620
V-412	3B24W	1, 2 & 4	800
			1500 AC
		3 NC	
		Cap	-445
			640 AC
V-413	3B24W	1, 2 & 4	-445
			640 AC
		3 NC	
		Cap (1)	-1620
V-414	3B24W	1, 2 & 4	800
			1500 AC
		3 NC	
		Cap	-445
			640 AC

All readings taken with power supply disconnected from R.F. head

(1) Depends on setting of R-416 Adj. 1610 Pot. (-1500 to -1700)

(2) 800 AC. & 360 DC. 2 or 8 to ground

.... All other measurements to Gnd. unless otherwise indicated.

Generator, Interference SG-112/URM

Tube		Pin No.	Voltage
V-501	6X4	1	250 AC
		2	NC
		3	300
			6.3 AC
		4	6.3 AC
		5	NC
		6	250 AC (2)
		7	300 (2)
V-502	OB2WA	1 & 5	210
		2, 4 & 7	105

Table 5-1, Tube Voltages (Cont'd)			
Generator, Interference SG-112/URM (Cont'd)			
V-503	OB2WA	1 & 5	105
		2, 4 & 7	0.0
V-504	5814A	1 & 6	224 (3)
		2 & 7	0.0 (3)
		3 & 8	21 (3)
		4 & 5	6.3 AC to pin 9
		9 to 4 & 5	6.3 AC

Voltages taken from circuit ground unless otherwise specified
(2) Plate to plate
(3) Pulsating with S502 ON in either ± position
Voltage readings taken with 20KΩ/Volt meter

These Notes are Applicable to the R-F Tuner Voltage and Resistance Diagrams Appearing on the Following FOUR Pages

GENERAL CONDITIONS

1. All resistance values are in ohms unless followed by "K" - kilohm (1,000 ohms) or "MEG" - megohm (1,000,000 ohms) and appear below the reference line.
2. All voltages are DC unless otherwise indicated, and appear above the reference line.
3. All measurements are made with respect to ground and are approximate (tolerance ±10%).
4. Resistance measurements are made with no power applied and with no external connections to the component. Multimeter TS-352/U used.
5. Voltage measurements are made with the equipment in an operating condition, but with no impressed signal. Where a dash (---) is used in lieu of a voltage value, no measurement can be made under operating condition. Significant equipment control positions or other conditions are noted as required in the referenced notes. Multimeter TS-352/U (20,000 ohms-per-volt) used for all measurements with the following scales:
   10-Volt Scale: All measurements below 10 volts.
   50-Volt Scale: All measurements between 10 and 50 volts.
   250-Volt Scale: All measurements between 50 and 250 volts.
   1,000-Volt Scale: All measurements above 250 Volts.
6. All sockets are shown as seen from wired side.
7. Receptacle connectors are shown as seen from wired side except those to which external cables are connected during operation. These external cable receptacle connectors, as well as plug connectors and test jacks, are shown as seen from the input side.

SPECIFIC CONDITIONS

8. CAUTION: Use of an ohmmeter in crystal rectifier circuits may damage the crystal, and even if no damage should occur, the readings are likely to be misleading. If a circuit containing a crystal rectifier requires a resistance test, first make sure that the crystal is disconnected and then refer to the schematic diagram for resistance values to be expected.
9. Value depends on R-F Tuner frequency.
10. With P1001 connected. Value in parentheses is that obtained with P1001 disconnected.
11. Values are those obtained with P1001 disconnected from J206.
12. Varies as Remote Control IF ATT'N is varied from 0 DB to 74 DB.
13. Varies with R-F Tuner frequency.
14. Do not measure: no significant reading.
15. Internal tube connection to Pin 1.
16. Internal tube connection to Pin 2.
17. All preamplifier voltage and resistance measurements made from top side of tube sockets using Tube Socket Adapter CV-49519.

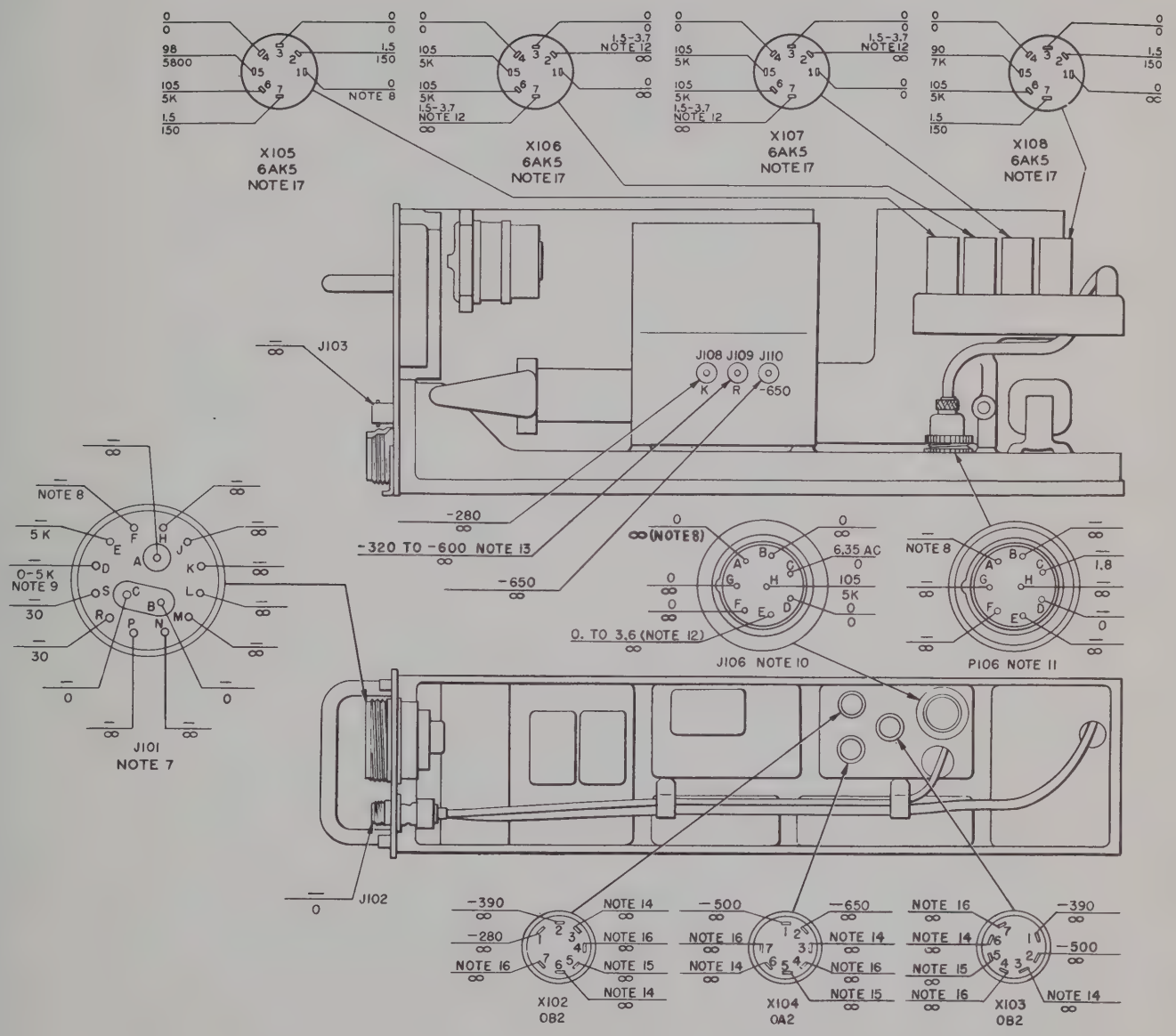


Figure 5-2, R-F Tuner TN-128A/APR-9, Voltage and Resistance Diagram

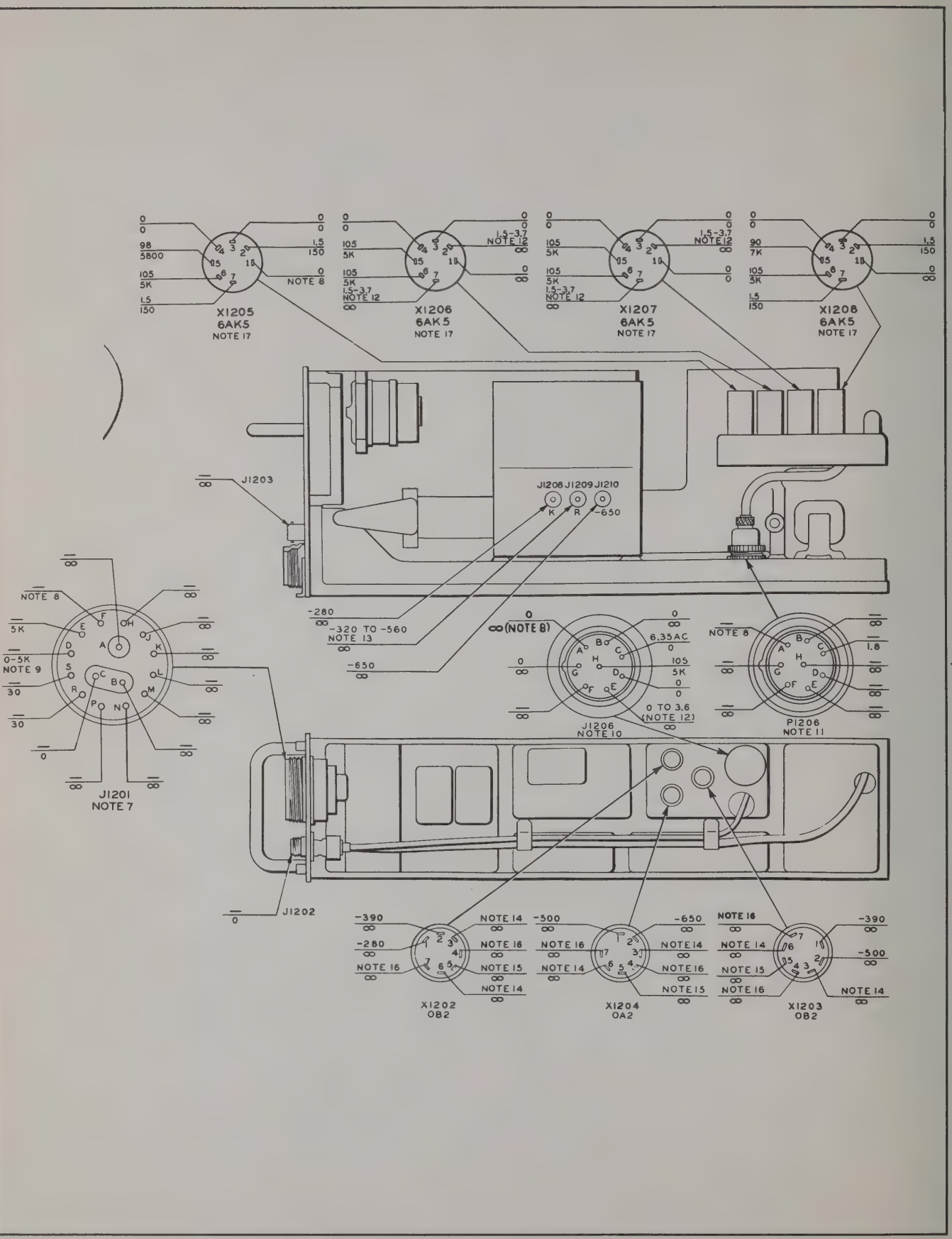


Figure 5-3, R-F Tuner TN-129C/APR-9, Voltage and Resistance Diagram

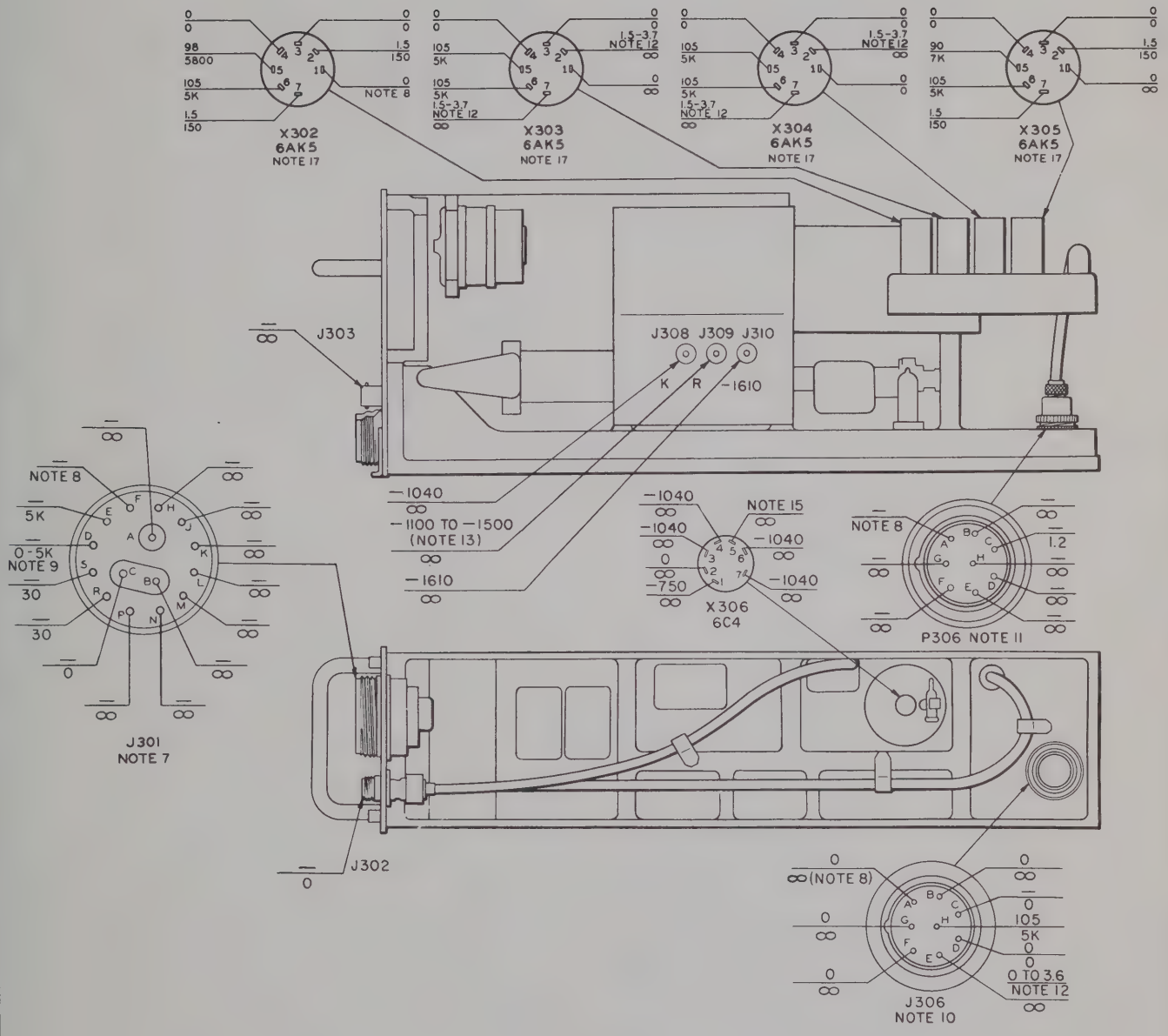


Figure 5-4, R-F Tuner TN-130A/APR-9, Voltage and Resistance Diagram

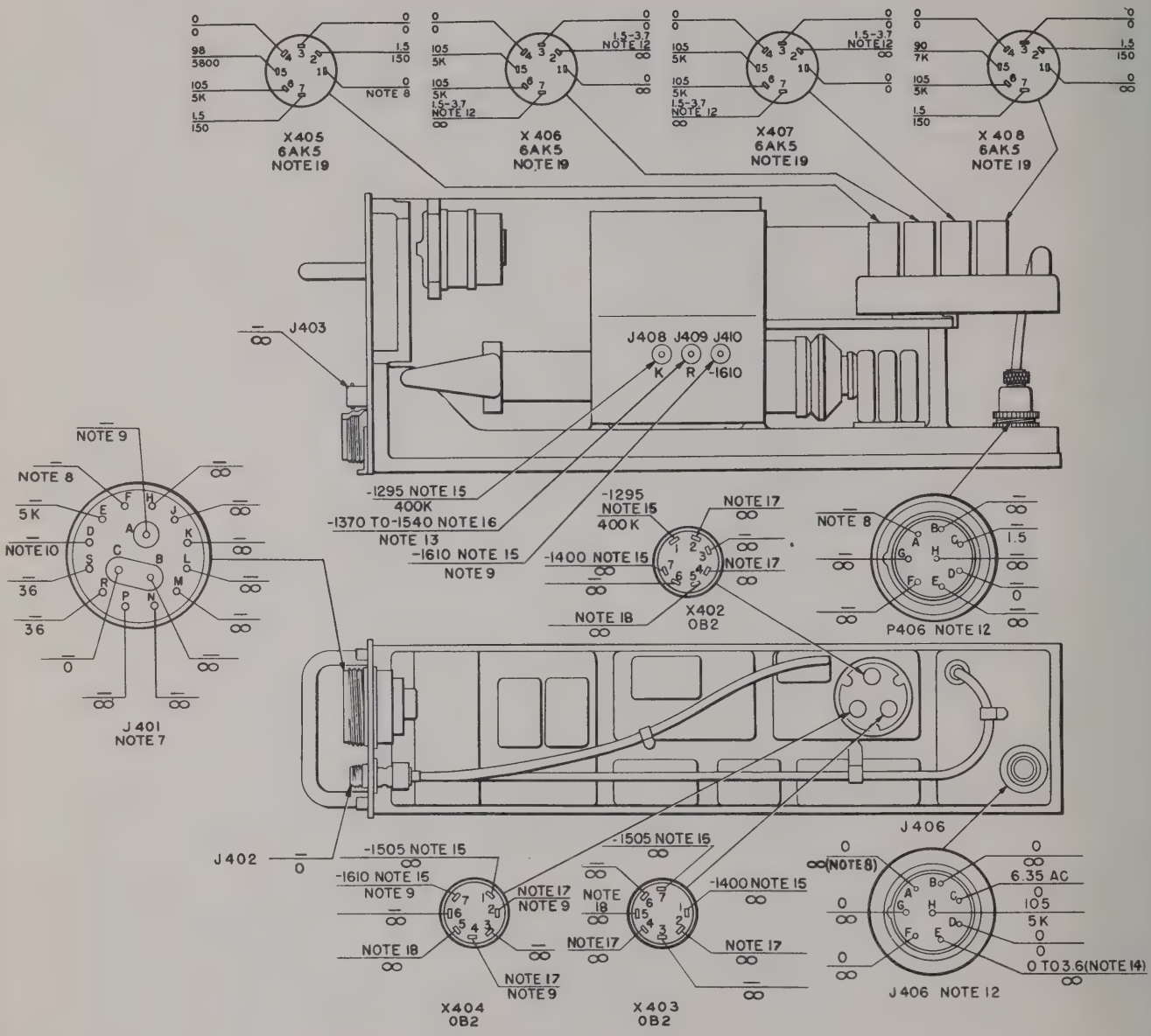


Figure 5-5, R-F Tuner TN-131B/APR-9, Voltage and Resistance Diagram

d. Replacement of Parts:

Defective parts should be replaced with correct replacement parts as listed in Section 6. Upon removing the defective part, install the replacement part in the exact position of the original part. Keep the leads on the replacement part the exact length of those of the original part.

When coaxial connectors have been disconnected during maintenance procedures, tighten the connectors firmly before placing the equipment in service. This is important to avoid discontinuities at the coaxial connectors which adversely affects the standing wave ratio on the coaxial line.

e. RI-FI Meter Power Supply, Output Voltage Adjustment:

The required value of B+ output voltage to the RI-FI meter from the RI-FI meter power supply is determined by the setting of the "reg adj" control R308 in the power supply. This control sets the grid bias for the control tube V302. The power line voltage should be adjusted to 115 volts for this adjustment. Connect the RI-FI Meter to the power supply to provide the proper load conditions. Remove the chassis from the case as outlined in paragraph 3e of this section and open the chassis. Connect a 20,000-ohm-per-volt voltmeter (i.e., Navy Model OE Series) between the positive terminal of C303 and ground. Adjust R308 for a +225-volt reading on the voltmeter. Tighten locknut on R308.

f. R-F Tuner Power Supply PP-1179/URM-42, —1610-Volt Adjustment:

Adjustment of the -1610-volt power supply must not be attempted unless either R-F Tuner TN-130A/APR-9 or TN-131B/APR-9 is in use. To set the -1610-volt output to its correct value, proceed as follows:

DANGER

WITH POWER SUPPLIED TO THE R-F TUNER POWER SUPPLY, VOLTAGES SUFFICIENT TO CAUSE DEATH ARE PRESENT. OBSERVE ALL SAFETY PRECAUTIONS.

Step 1. Make certain that power is not applied to the R-F tuner power supply. This can be accomplished by positioning the POWER OFF - ON switch on the power supply to the OFF position.

Step 2. Using an appropriate multimeter (i.e., Navy Model UE-1), set the controls for a reading on the 5000-volt d-c scale; connect the positive lead to a convenient ground on the R-F Tuner (TN-130A/APR-9 or TN-131B/APR-9).

Step 3. Set the POWER OFF - ON switch on the R-F tuner power supply to ON. Allow a minimum warmup period of 10 minutes.

Step 4. Connect the negative lead of the multimeter to test jack J310 of the TN-130A/APR-9, or to test jack J410 of the TN-131B/APR-9, as required. The meter reading should be -1610 volts, ±1%.

Step 5. If the meter reading is other than that specified in step 4, adjust adj -1610 potentiometer R416 on the R-F tuner power supply until the voltage as read on the meter is -1610 volts, ±1%. Tighten locknut on R416.

g. R-F Tuner Power Supply PP-1179/URM-42, —650-Volt Adjustment:

Adjustment of the -650-volt power supply must not be attempted unless either R-F Tuner TN-128A/APR-9 or TN-129C/APR-9 is in use. To set the -650-volt output to its correct value, proceed as follows:

DANGER

WITH POWER SUPPLIED TO THE R-F TUNER POWER SUPPLY, VOLTAGES SUFFICIENT TO CAUSE DEATH ARE PRESENT. OBSERVE ALL SAFETY PRECAUTIONS.

Step 1. Make certain that power is not applied to the R-F tuner power supply. This can be accomplished by positioning the POWER ON - OFF switch on the power supply to the OFF position.

Step 2. Using an appropriate multimeter (i.e., Navy Model UE-1), set the controls for a reading on the 1000-volt d-c scale; connect the positive lead to a convenient ground on the R-F tuner in use.

Step 3. Set the POWER OFF- ON switch on the R-F tuner power supply to ON. Allow a minimum warmup period of 10 minutes.

Step 4. Connect the negative test lead to test jack J110 of the TN-128A/APR-9, or to test jack J1210 of the TN-129C/APR-9, as required. The meter reading should be -650 volts, ±1%.

Step 5. If the meter reading is other than that specified in step 4, adjust adj -650 potentiometer R405 on the R-F tuner power supply until the voltage as read on the meter is -650 volts, ±1%. Tighten locknut on R405.

Step 6. Adjust "GAIN 160-MC I-F" control R425 maximum clockwise for minimum resistance. Tighten locknut on R425.

h. Burnishing Impulse Noise Line Contacts:

At periodic intervals of approximately 100 operating hours, operation of the Generator, Interference SG-112/URM should be checked for constancy of output pulse amplitude. Variations in pulse amplitude are indicative of defective impulse noise line contacts and require corrective measures to prevent spurious signal measurements. Excessive pulse variations can be detected in the following manner:

(1) Set up the equipment for normal operation and apply power; permit a suitable warmup period before proceeding.

(2) Refer to Section 4, paragraph 4c and accomplish steps 1 through 11, inclusive. The

test frequency shall be 2.0 kmc/s.

(3) Note the indicating meter reading in decibels.

(4) Slowly rotate the PEAK control counter-clockwise until all pulses from the impulse noise generator are heard in the headphones. Do not exceed this point.

(5) Note the indicating meter reading in decibels.

(6) Subtract the reading of step 5 from the reading taken in step 3. If the difference is less than two decibels, the impulse noise generator is functioning normally. However, should the difference be of the order of two decibels or greater, dirty impulse noise line contacts are indicated and the following corrective procedures must be followed.

(a) Remove the impulse noise generator chassis from the instrument case and free the front panel from the chassis as outlined in paragraph 3f of this section.

(b) Disconnect the r-f cable from the PULSE OUTPUT receptacle.

(c) Loosen the two set screws holding the PULSE OUTPUT receptacle in the assembly with a No. 6 Allen wrench.

(d) Utilizing a piece of 1/16-inch metal as a screwdriver, insert it into the slots in the end of the receptacle and loosen the receptacle body, then unscrew the connector body by hand. The connector body, connector pin, a series film resistor, a shunt resistor and the discharge contact and housing should remove as a unit. If only the connector body comes away, remove the remaining pieces as a unit.

(e) Lay a piece of clean, white bond paper on a flat surface and, holding the connector body vertical, burnish the contact on the inner end of the connector by sliding over the paper, utilizing a circular motion, until all blackened deposit on the contact is removed. Do not use sandpaper, crocus or emery cloth.

(f) Replace and tighten the connector body in the impulse noise line. Tighten set screws.

CAUTION

BEFORE REPLACING THE CONNECTOR BODY INSPECT THE NOISE LINE INTERIOR TO SEE THAT THE MOVABLE CONTACTOR IS IN PLACE. IRREPARABLE DAMAGE CAN EASILY BE DONE TO THE SMALL CONTACT (.006" DIAMETER) IF PRESSURE IS APPLIED TO IT.

(g) Connect the r-f cable to the output receptacle (PULSE OUTPUT) of the impulse noise generator.

(h) Apply power to the equipment and check operation of the impulse noise generator. If operation is still unsatisfactory, remove power from the equipment and continue as follows:

(i) Turn the front panel of the impulse noise generator on its face so that the interior end of the impulse noise line is accessible, remove the wiring shield, and unsolder the lead to the feedthru capacitor input terminal of the impulse noise line.

(j) Unscrew the feedthru capacitor from the input tube and draw it straight out of the tube; the charging resistor and contact will come away with the capacitor.

(k) Hold the charging contact as near the contact end as possible and burnish as outlined in step (e) above. Be very careful not to bend or otherwise damage the contact and resistor assembly.

(l) Replace the assembly in the input tube and tighten the capacitor in place.

(m) Resolder the lead to the feedthru capacitor, replace the wiring shield, and apply power to the equipment, checking operation of the unit. If operation is still unsatisfactory, remove power from the equipment and continue as follows.

(n) Return the front panel to its face up position and remove the r-f cable from the PULSE OUTPUT receptacle.

(o) Remove the receptacle as outlined in steps (c) and (d) above.

(p) Very slowly, turn the front panel on its face and, holding a hand below the receptacle opening of the impulse noise line, shake the panel until the center, movable contactor of the line falls out of the assembly into the hand.

CAUTION

EXERCISE EXTREME CARE IN HANDLING THE CONTACTOR SINCE THE DISCHARGE CONTACT IS OF EXTREMELY SMALL DIAMETER AND IS SUBJECT TO CONSIDERABLE DAMAGE WHEN MISHANDLED.

(q) Holding the contactor with a light finger grip, burnish the larger of the two axially located contacts (charging contact) as outlined in step (e) above.

(r) Then, very carefully, clean the side of the smaller, discharge contact by scraping with the edge of a strip of clean white bond paper; do not burnish the contact point. If an eye-glass or microscope is available, inspect the small contact for lint and other foreign particles.

(s) Inspect the body of the contactor. Remove any foreign particles or surface irregularities that might impede its travel within its insulating sleeve.

(t) With a pair of tweezers, return the contactor to its position within the impulse noise line; the larger contact must enter the opening first.

CAUTION

THE CONTACTOR IS A CLOSE TOLERANCE FIT

WITHIN ITS INSULATING SLEEVE AND MUST NOT BE FORCED. IF THE CONTACTOR DOES NOT COMPLETELY ENTER ITS SLEEVE, BECAUSE OF INCORRECT ALIGNMENT, TOUCHING THE HIGH OUTER EDGE WILL BE SUFFICIENT TO START ENTRY.

(u) Replace the receptacle and secure as outlined in step (f) above.

(v) Reconnect the r-f cable to the PULSE OUTPUT receptacle and apply power to the equipment. Operation of the unit should now be satisfactory.

(w) Replace the panel and chassis in the instrument case as outlined in paragraph 3f of this section.

5. TEST AND MISCELLANEOUS EQUIPMENT REQUIRED FOR ALIGNMENT, ADJUSTMENT, AND CALIBRATION PROCEDURES

a. Signal Generator TS-403/U (or equivalent) (1800 to 4000 mc/s)
b. Signal Generator TS-419/U (or equivalent) (900 to 2100 mc/s)
c. Signal Generator TS-497/URR (or Measurements Corporation Model 80 (or equivalent.)
d. Signal Generator TS-621/U (or equivalent) (3800 to 7600 mc/s)
e. Signal Generator TS-622/U (or equivalent) (7000 to 10750 mc/s)
f. 6 db, 50-ohm pad for output termination of signal generator TS-497/URR.
g. Nutdriver (3/16 inch) for adjustment of i-f coils.
h. Nutdriver (1/2 inch) for potentiometer locking nuts
i. Screwdriver for adjustment of potentiometers
j. Electronic Multimeter ME-25/U, Multimeter AN/PSM-4, VTVM Measurements Corp. Model 162, or equivalent 20,000-ohm-per-volt multimeter

6. SETUP OF EQUIPMENT FOR ALIGNMENT AND ADJUSTMENT OF THE RI-FI METER

NOTE

PROCEDURES FOR SETTING UP THE NECESSARY TEST EQUIPMENT FOR THE ALIGNMENT AND ADJUSTMENT OF THE R-F TUNERS IS CONTAINED IN THE APPROPRIATE HANDBOOK OF SERVICE INSTRUCTION: AN 16-30APR9-12.

BEFORE COMMENCING ALIGNMENT AND ADJUSTMENT OF THIS EQUIPMENT, CHECK THE MECHANICAL ZERO SETTING OF THE FRONT PANEL METER. IT IS POSSIBLE THAT CORRECTING THIS ZERO SETTING WILL CORRECT THE SYMPTOMS OF MISALIGNMENT OR MALADJUSTMENT AND THE EQUIPMENT CAN BE RETURNED TO SERVICE.

Step 1. Remove the RI-FI meter from Case, Radio Interference Measuring Set CY-1648/URM-42 and remove the chassis from the instrument case. Set up on a bench or convenient surface.

Step 2. Interconnect the RI-FI meter and the RI-FI meter power supply by means of Cable Assembly CADV-62481 (10'0"). Connect the RI-FI meter power supply to the external power source using one of the Cable Assemblies CADV-62480 (6'0"). Ground the clip at the input end of this cable.

7. PRELIMINARY CHECKS PRIOR TO ACTUAL ALIGNMENT AND ADJUSTMENT

Step 1. Operate the RI-FI Meter power supply POWER switch S301 to the ON position. Allow a one-hour warmup period before beginning alignment and adjustment procedures.

Step 2. Check voltages at the following points on the terminal board under the chassis of the RI-FI Meter:

a. B+ terminal: +225 volts dc.

b. 6.3-volt terminal: approximately 6.3 volts ac. Also available between chassis and pin 3 of any of the 7-pin miniature tube sockets.

c. Bias voltage terminal: approximately 17 volts dc negative to chassis, available at R192 on the terminal board.

8. ALIGNMENT AND ADJUSTMENT PROCEDURES

NOTE

PROCEDURES FOR THE ALIGNMENT AND ADJUSTMENT OF THE FOUR R-F TUNERS SUPPLIED WITH THE AN/URM-42 EQUIPMENT ARE CONTAINED IN THE HANDBOOK OF SERVICE INSTRUCTIONS FOR RADAR SET AN/APR-9, -9A, -9B: AN 16-30APR9-12.

a. Preliminary Meter Tracking Adjustments:

(1) Adjustment of Electrical Zero:

Step 1. Setup of operating controls:

Attenuator.....X10
Function Switch (S102).....FI

Step 2. Short out the input of the VTVM circuit by placing a jumper between the two terminal board terminals marked "METER ZERO".

Step 3. Zero the indicating meter M101 "ADJ ZERO" contro R196 located on top of the chassis directly behind the indicating meter.

Step 4. Remove V107 and V111 from their sockets. Remove the jumper across the meter zero terminals and observe that the output meter indication remains at zero. Should the meter indication swing negative (below zero on microvolt scale), gas current is present in V112. Replace V112 with a tube that does not exhibit

this characteristic. Usually, a new tube must be "aged" or used in the circuit from 5 to 15 hours to minimize an inherent tendency to develop gas current. After the meter zero is adjusted and V112 is satisfactorily installed, place V107 and V111 in their sockets and tighten the locknut on R196.

(2) Preliminary Adjustment of the FI 100 Control:

Step 1. Setup of operating controls:

Attenuator.....X10
Function Switch (S102).....FI

Step 2. Using a 20,000-ohms-per-volt meter, connect the negative lead to the chassis (ground) and the positive lead to the arm of the FI 10 control R177. Select a voltmeter range to conveniently measure 95 volts dc, and adjust R177 so that the meter indicates that value. Then place the positive lead to the arm of FI 100 control R147 and ground (to chassis) the negative lead. Select a voltmeter scale to conveniently measure 20 volts dc, and adjust potentiometer R147 for a voltmeter indication of that value.

(3) Preliminary Adjustment of Diode Bucking Voltage Control:

Step 1. Setup of operating controls:

Attenuator.....$X10^2$
Function Switch (S102).....FI
CAL control (R136).....Fully counterclockwise

Step 2. Adjust the FI Buck control R181 to provide approximately 1% (1/16 inch) deflection of M101. If R181 has no control, proceed to paragraph 8a(5), Preliminary Alignment of $X10^2$ Attenuator Control.

(4) Preliminary Adjustment of $X10^2$ Attenuator Control:

Step 1. Setup of operating controls:

Attenuator.....$X10^2$
Function Switch (S102).....FI
CAL control (R136).....Maximum clockwise

Step 2. Using a 20,000-ohms-per-volt meter, connect the negative lead to the chassis (ground) and the positive lead to the arm of the Atten 10^2 control R132. Select a voltmeter range to conveniently measure 5.5 volts dc and adjust R132 for a voltmeter indication of that level.

b. Intermediate-Frequency Alignment:

(1) Setup of Equipment for I-F Alignment:

Step 1. Connect the R-F Transmission Line (Cable Assembly CG-92D/U (20'0") between the IF INPUT receptacle J107 on the RI-FI meter and the output of signal generator TS-497/URR with a 50-ohm, 6 db matching impedance.

Step 2. Plug headphones into either of the two RI-FI meter AUDIO OUTPUT receptacles.

(2) Alignment of I-F Transformers:

Step 1. Setup of operating controls:

Attenuator.....X10
Function Switch (S102).....FI
CAL control (R136).....As called for

Step 2. Adjust the output frequency of Signal Generator TS-497/URR to exactly 60 megacycles. Adjust the output level of the signal generator to 1000 microvolts. Adjust the CAL control in this and following steps to provide a convenient mid-scale indication on meter M101 on the RI-FI meter.

Step 3. Using the 3/16-inch nutwrench, output i-f transformers L203, T104, and T107 for maximum indication on M101.

Step 4. Adjust the signal generator output frequency to exactly 60.7 megacycles. Adjust i-f transformers T102 and T105 for maximum indication on M101.

L203 will tune very broadly.

Step 5. Adjust the signal generator output frequency to exactly 59.3 megacycles. Adjust i-f transformers T103 and T106 for maximum indication on M101.

Step 6. Repeat Steps 2, 3, 4 and 5 until the i-f transformers are adjusted for absolute maximum meter indication.

Step 7. Adjust signal generator output frequency to exactly 160 megacycles. Adjust the signal generator output level to provide a convenient mid-scale indication on meter M101. Then vary the signal generator frequency for maximum indication on meter M101. Note frequency. It should be within one or two megacycles of 160 megacycles. If the deviation is greater than this tolerance, L204 requires adjustment.

c. Final Meter Tracking Adjustments:

(1) Setup of Equipment for Meter Tracking Adjustments:

Use the setup described under i-f alignment, paragraph 8b(1).

(2) Final Adjustment of the FI 100, FI 10 and FI Buck Controls:

Step 1. Setup of operating controls:

Attenuator.....$X10^2$
Function Switch (S102).....FI
CAL control (R136)..... As called for

Step 2. Adjust the signal generator to supply an unmodulated 60-megacycle signal and adjust its output level to 100 microvolts.

Step 3. Adjust CAL control to provide an indication of 1 microvolt on M101.

Step 4. Adjust the signal generator output level to 10,000 microvolts. Adjust the FI 100 control R147 to provide an indication of 100 microvolts on M101.

Step 5. Repeat steps 2, 3, and 4 until the FI 100 control requires no further adjustment.

Step 6. Adjust the signal generator output level to 1000 microvolts. M101 should indicate 10 microvolts, if not, adjust FI 10 control R177 to provide the proper indication.

Step 7. Temporarily reduce the signal generator output to zero. Adjust the CAL control fully counterclockwise. Adjust the FI Buck control R181 to

provide approximately 1% (1/16-inch) deflection of M101.

Step 8. Repeat Steps 2, 3, 4, 5, 6 and 7 as required to obtain exact meter tracking.

Step 9. Tighten the locknuts on R147, R177, and R181.

(3) Final Adjustment of the QP 100 and QP 1 Controls:

Step 1. Setup of operating controls:

Attenuator.....$X10^2$
Function Switch (S102).....As called for
CAL control (R136).....As called for

Step 2. Set the function switch to the FI position. Set the signal generator to supply an unmodulated 60-megacycle signal and adjust its output level to 10,000 microvolts.

Step 3. Adjust the CAL control to provide an indication of 100 microvolts on M101.

Step 4. Set the function switch to the QP position. Adjust the QP 100 control R178 to provide an indication of 100 on M101.

Step 5. Set the function switch to the FI position. Adjust the output level of the signal generator to provide an indication of 1 microvolt on M101.

Step 6. Set the function switch to QP position. Adjust the QP 1 control R179 to provide an indication of 1 microvolt on M101.

Step 7. Repeat steps 2, 3, 4, 5, and 6, as required to obtain exact meter scale tracking.

Step 8. Tighten the locknuts on R178 and R179.

(4) Final Adjustment of the Peak Buck and Peak 100 Controls:

Step 1. Setup of operating controls:

Attenuator.....$X10^2$
Function Switch (S102).....As called for
CAL control (R136).....As called for
AUDIO control (R213).....Fully clockwise.

Step 2. Set the function switch to the QP position. Set the signal generator to provide a 30%-modulated (400 cycles), 60-megacycle signal and adjust the signal generator output to 100 microvolts. Adjust the CAL control to provide an indication of 1 microvolt on M101.

Step 3. Set the function switch to PEAK. Using headphones, adjust the PEAK control R170 for an M101 indication of 1 microvolt. Adjust the Peak Buck control R180 to a position where the 400-cycle audible signal just disappears.

Step 4. Set the function switch to the QP position. Adjust the signal generator output level to 5000 microvolts with 30% modulation (400 cycles) and adjust the CAL control for an M101 indication of 80 microvolts.

Step 5. Set the function switch to PEAK. Adjust the PEAK control R170 for an M101 indication of 80 microvolts. Adjust the PEAK 100 control R198 (marked QP-10 on chassis potentiometer bracket) to a position where the 400-cycle audible signal just disappears.

Step 6. Repeat steps 2, 3, 4 and 5 as required to obtain exact meter scale tracking.

Step 7. Tighten the locknut on R180 and R198.

(5) Final Adjustment of the Attenuator $X10^2$ Control:

Step 1. Setup of operating controls.

Attenuator.....As called for
Function Switch (S102).....FI
CAL control (R136).....As called for

Step 2. Set the Attenuator to X10. Set the signal generator to supply an unmodulated 60-megacycle signal and adjust the signal generator output level to exactly 1000 microvolts.

Step 3. Adjust the CAL control to provide an indication of 100 microvolts on meter M101.

Step 4. Set the Attenuator to $X10^2$. Adjust the signal generator output level to exactly 10,000 microvolts. Adjust ATTEN $X10^2$ control R132 for an indication of 100 microvolts on M101.

Step 5. Repeat Steps 2 through 4 until R132 requires no further adjustment.

Step 6. Tighten the locknut on R132.

9. CORRECTING THE CALIBRATION CHART SET AFTER ALIGNMENT

a. General:

Data on charts #1 through #4 has been recorded and plotted for the individual equipment as shipped. Upon completion of the calibration and adjustment procedures contained in paragraph 8 of this section, it is necessary to obtain new data and revise these pages accordingly.

After Radio Interference Measuring Set AN/URM-42 has been aligned in accordance with the instructions in paragraph 8, obtain data for charts #1 through #4 of the chart set at each of the following calibrating frequencies:

Table 5-2, Calibration Frequencies (in kilomegacycles)

R-F TUNER	FREQUENCIES
TN-128A/APR-9	1.0, 1.4, 1.8, 2.2, 2.6
TN-129C/APR-9	2.3, 2.8, 3.2, 3.8, 4.4
TN-130A/APR-9	4.3, 4.9, 5.5, 6.1, 6.5, 7.1
TN-131B/APR-9	7.1, 7.7, 8.5, 9.3, 9.9, 10.7

b. Calibrating Procedure:

(1) Calibration Settings:

Allow a minimum of 30 minutes for the equipment warmup period before beginning the calibrating procedure. Allow a minimum of one hour warmup of the signal generator before using; a 30 minute warmup period should also be allowed each R-F Tuner after placing it in operation.

Step 1. Setup of operating controls:
Attenuator.....X10
Function Switch (S102).....FI
PEAK control (R170).....As called for
TUNE.....As called for
Input Coaxial Switch.....As called for
R-F Tuner.....TN-128A/APR-9

Step 2. Using the 20 ft. R-F Transmission Line Cable Assembly CG-92D/U (20'0"), connect the receptacle corresponding to position 2 of the input coaxial switch to the output receptacle of signal generator TS-419/U. Set the input coaxial switch to position 2.

Step 3. Adjust the signal generator output frequency to 1.0 kmc/s. Adjust the output level of the signal generator to 1000 microvolts.

NOTE

THE ABSOLUTE VALUE OF CALIBRATION DEPENDS UPON THE ACCURACY OF THE CALIBRATING SIGNAL SOURCE.

Step 4. Tune the R-F Tuner for maximum response to the test signal and check occasionally thereafter to correct for drift. Adjust the CAL control for a meter indication of 100 microvolts.

Step 5. Set the function switch to its PEAK position.

Step 6. Adjust the input coaxial switch to position 1, the impulse noise generator input.

Step 7. Turn the PULSE ON-OFF switch on the impulse noise generator to its ON position.

Step 8. Rotate the PEAK control counterclockwise until pulses from the impulse noise generator can be heard in the headphone. Then, slowly, turn the PEAK control clockwise until the headphone signal just becomes inaudible. If necessary, advance the AUDIO control to a high level to facilitate establishment of this threshold point. Do not advance the PEAK control beyond the point of inaudibility. Observe the pointer of the indicating meter as the point of inaudibility is approached. If the meter goes off scale, advance the attenuator control to the next higher position and repeat the foregoing procedure of this step. Note the meter indication on the db scale and the attenuator step and record. This is the calibration setting at this test frequency.

NOTE

THE IMPULSE NOISE GENERATOR OUTPUT VARIES ACROSS THE FREQUENCY RANGE OF EACH R-F TUNER. CHOOSE THE LOWEST ATTENUATOR STEP THAT WILL CONTAIN ALL CALIBRATION SETTINGS ON THE METER SCALE FOR A GIVEN R-F TUNER.

Step 9. Repeat steps 3 through 8 for each of the test frequencies for each of the four R-F Tuners, changing signal generators as necessary.

Step 10. Repeat steps 3 through 9 using the six-foot RF transmission line CG-92D/U (6'0") and position 3 of the coaxial switch.

Step 11. Using the vertical scale of charts #1 through #4 of Chart Set, Calibration PT-320/URM-42, plot the values of calibration pulse amplitude in db which were determined in step 8. Draw a smooth curve through the plotted points. Record the corresponding attenuator settings.

(2) Bandwidth Data:

For all practical purposes, the bandwidth of this equipment is entirely determined by the 60-megacycle i-f amplifier. Therefore, the bandwidth can be determined by measurements on Meter, Radio Frequency Interference IM-103/URM-42.

Step 1. Setup the following operating controls:
Attenuator.....X10
Function Switch (S102).....FI

Step 2. Connect the output of signal generator TS-497/URR to the IF INPUT receptacle (J107) of the RI-FI meter using the 20 ft. R-F Transmission Line.

Step 3. Adjust the output frequency of the signal generator for maximum response of the indicating meter; this frequency will approximate 160 megacycles. Adjust the output level to exactly 1000 microvolts.

Step 4. Adjust the CAL control for M101 indication of 60 microvolts.

Step 5. Increase the signal generator output by exactly 6 db (to 2000 microvolts).

Step 6. Tune the signal generator to a lower frequency of approximately 150 megacycles and, then, slowly, increase the frequency beyond 160 megacycles. Observe and note the two signal generator frequencies at which M101 indicates 60 microvolts. Record the difference in frequency between the two observed points; this is the 6 db bandwidth.

NOTE

IN ORDER TO COUNTERACT BACKLASH IN THE SIGNAL GENERATOR TUNING MECHANISM, ALWAYS SWEEP THE SIGNAL GENERATOR FREQUENCY CONTINUOUSLY IN ONE DIRECTION FROM A POINT BELOW THE CALIBRATING FREQUENCY TO A POINT ABOVE THE FREQUENCY. THE TWO FREQUENCIES WILL BE QUITE CLOSE TOGETHER SO USE THE VERNIER MARKINGS ON THE SIGNAL GENERATOR TUNING KNOB FOR ACCURATE READINGS.

Step 7. Record the 6 db bandwidth in the space provided on page 1 of the Chart Set, Calibration PT-320/URM-42.

NOTE

THE EFFECTIVE IMPULSE NOISE BANDWIDTH

IS 1.05 TIMES THE 6 DB BANDWIDTH. THE EFFECTIVE RANDOM NOISE BANDWIDTH IS 0.78 TIMES THE 6-DB BANDWIDTH.

(3) Antenna Factors:

Correction factors for use with the small cone antenna which appear on page 4 of the chart set are not influenced by realignment of the RI-FI Meter. No correction need be made on this page.

SECTION 6

PARTS LIST

SYMBOL DESIG.	STANDARD NAVY STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION	MFR. NO.	STODDART NO.
		RADIO FREQUENCY INTERFERENCE METER IM-103/URM-42			
C101 thru C115		Not used.			
C116	N16-C-31095-6404	CAPACITOR, FIXED, MICA DIELECTRIC: 1000 mmf, ±10%; 500 vdcw	B+ by-pass at V104	CAN #M-28	10365-102
C117		Same as C116	V104 Cathode by-pass		
C118		Same as C116	V104 screen by-pass		
C119	N16-C-18787-8062	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 1500 mmf; ±20%; 500 vdcw	Heater by-pass, V104	CER #362	10364
C120		Same as C119	B+ by-pass, V105		
C121		Not used.			
C122	N16-C-15367-4801	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 1.0 mmf; ±20%; 500 vdcw	Compensating capacitor at V105	CAUZ #JP-5/32	10367
C123		Same as C116	Screen by-pass V105		
C124		Same as C119	Heater by-pass V105		
C125 thru C130		Not used.			
C131		Same as C119	B+ by-pass, V106		
C132		Same as C122	Compensating capacitor, V106		

SYMBOL DESIG.	STANDARD NAVY STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION	MFR. NO.	STODDART NO.
C133		Same as C116	Screen by-pass V106		
C134		Same as C119	Heater by-pass V106		
C135		Not Used.			
C136		Same as C119	B+ by-pass V107		
C137		Same as C122	Compensating Capacitor, V197		
C138		Same as C119	Heater by-pass V107		
C139		Same as C116	Screen by-pass V107		
C140 thru C145		Not used.			
C146		Same as C119	B+ by-pass, V108		
C147		Same as C119	Heater by-pass V108		
C148		Same as C116	Screen by-pass V108		
C149		Not used.			
C150		Same as C119	B+ by-pass, V109		
C151		Same as C116	Cathode bias, V109		
C152		Same as C119	Heater by-pass V109		
C153	N16-C-18661-1200	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 1000 mmf: +100%, -0%; 500 vdcw; disc type	Screen coupling	CBN #DD-102	10368
C154	N16-C-29454-8532	CAPACITOR, MICA DIELECTRIC: 240 mmf; ±10%, 500 vdcw	Neutralizing Capacitor, V109	CAN #M-28	10365-241

SYMBOL DESIG.	STANDARD NAVY STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION	MFR. NO.	STODDART NO.
C155 thru C159		Not used.			
C160	N16-C-19556-4420	CAPACITOR, FIXED, TANTALUM: 10 mfd; -15% +50%; 25 vdcw	Cathode by-pass V114	CATD #PP10B25A2	10459
C161		Same as C119	IF filter by-pass, V110		
C162		Same as C116	Heater by-pass at V110		
C163		Same as C119	IF filter at V110		
C164	N16-C-45773-6728	CAPACITOR, FIXED, PAPER DIELECTRIC: Navy type (-484944-10); 100,000 mmf; ±10%; 400 vdcw	Weighting circuit capacitor	CAMD #ME	10101
C165A C165B C165C	N16-C-22732-7805	CAPACITOR, FIXED, ELECTROLYTIC: JAN type #CE33E400M; 3 sections; 40-40-40 mfd, 250 vdcw	(a) and (b), B- Filter to V114 (c) Cathode bias V115B	CD CE33E400M	10137
C166	N16-C-19111-1136	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 10,000 mmf +80% -20%; 450 vdcw; disc type	Audio coupling to V115A	CBN #BN	10369
C167		Same as C166	Cathode by-pass at V115A		
C168		Same as C166	Coupling to pulse stretcher V116		
C169		Same as C153	Plate by-pass V116		
C170		Same as C166	RF by-pass at J101		
C171		Same as C166	RF by-pass at J101		

SYMBOL DESIG.	STANDARD NAVY STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION	MFR. NO.	STODDART NO.
C172		Same as C164	Weighting circuit capacitor		
C173	N16-C-47335-7210	CAPACITOR, FIXED, PAPER DIELECTRIC: JAN type #CP53B1FF504X; 0.5 mfd +20% -10%; 600 vdcw	Screen by-pass, V114	CD #DYR-6050J	10021
C174		Same as C166	RF by-pass at J102 J103		
C175		Same as C166	Audio coupling, V116		
C176 thru C200		Not used.			
C201	N16-C-18206-6907	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 500 mmf; 500 vdcw; ±10%	Cathode coupling capacitor, V201	CASU #CN-1-500K	10744
C202		CAPACITOR, FIXED, CERAMIC DIELECTRIC: 33mmf, ±5%; 500 vdcw	Low pass filter	CER #CC20RH330J	10735
C203	N16-C-30167-1968	CAPACITOR, FIXED, MICA DIELECTRIC: 500 mmf, ±10%; 500 vdcw	IF by-pass	CAN #M-28-500	10365-501
C204	For replacement use SNSN N16-C-18657-8801	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 1000 mmf, ±20%; 500 vdcw; feed-thru type	B+ terminal by-bypass, V201	CASU #CF-1-1000	10746
C205	For replacement use N16-C-15357-1248	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 12mmf, ±10% 500 vdcw	Grid coupling capacitor, V201	CASU #CN-1-12K	10745
C206		Same as C204	Oscillator tank by-pass		
C207		Same as C204	Filament by-pass V201		
C208 thru C300		Not used.			

SYMBOL DESIG.	STANDARD NAVY STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION	MFR. NO.	STODDART NO.
E101		Not used.			
E102		Not used.			
E103	N16-S-34520-3862	SHIELD, TUBE: JAN type #TSF0T101	Shield for V110	CEB #SOS-3	10113
E104	N16-S-34557-8351	SHIELD, TUBE: JAN type #TSF0T102	Shield for V104	CEB #SOS-6	10116
E105		Same as E104	Shield for V105		
E106		Same as E104	Shield for V106		
E107		Same as E104	Shield for V107		
E108		Same as E104	Shield for V108		
E109	N16-S-34607-6039	SHIELD, TUBE: JAN type #TSF0T103	Shield for V109	CMG #8698-1	10039
E110		Same as E103	Shield for V116		
E111		Same as E104	Shield for V111		
E112		Same as E104	Shield for V112		
E113		Same as E104	Shield for V113		
E114		Same as E104	Shield for V114		
E115	N16-S-34567-6513	SHIELD, TUBE: JAN type #TSF0T105	Shield for V115	CMG #16G1337B	10410
E116	N16-N-30826-1076	NETWORK, IMPEDANCE MATCHING: 50 ohms	Disconnected	CADV #90831-1	90831-1
E117	N16-T-25301-1231	TRANSMISSION LINE SECTION; 3 in. lg; 50 ohms	Used in X10 Attenuator position	CADV #90388-1	90388-1

SYMBOL DESIG.	STANDARD NAVY STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION	MFR. NO.	STODDART NO.
E118		Same as E117	Used in $X10^2$ Attenuator position		
E119	N16-A-97144-7001	RESISTOR ASSEMBLY, FIXED: attenuates 20 db; 50 ohms impedance	Used in $X10^3$ Attenuator position	CADV #90389-1	90389-1
E120	N16-A-97192-1001	RESISTOR ASSEMBLY, FIXED: attenuates 40 db; 50 ohms impedance	Used in $X10^4$ Attenuator position	CADV #90389-2	90389-2
E121	N16-A-97197-1001	RESISTOR ASSEMBLY, FIXED: attenuates 60 db; 50 ohms impedance	Used in $X10^5$ Attenuator position	CADV #90389-3	90389-3
E122	N16-K-700061-438	KNOB, BAR: black phenolic; white arrow marking	S102 knob	DMC #AC64969-1	10134
E123		Same as E122	S103 knob		
E124	N16-K-700301-999	KNOB, ROUND: black aluminum	CAL R136 knob	CADV #10135	10135
E125		Not used			
E126		Not used			
E127		Same as E124	PEAK R170 knob		
E128		Same as E124	AUDIO R213 knob		
E129		Not used			
E130	N16-K-700362-207	KNOB, ROUND: fluted; black phenolic	Attenuator knob	CAUP #S-309-64-DL-522	10353
E131	N17-C-945001-850	COVER, PHONE JACK:	Cover for REMOTE METER jack (J101)	CAHW #A23559	10311
E132		Same as E131	Cover for AUDIO OUTPUT J102		

SYMBOL DESIG.	STANDARD NAVY STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION	MFR. NO.	STODDART NO.
E133		Same as E131	Cover for AUDIO OUTPUT J103		
E134 thru E200		Not used			
E201		Same as E115	Shield for V201		
E202 thru E300		Not used			
J101	N17-J-39449-4770	JACK, TELEPHONE: Navy type (-491957)	Remote meter receptacle	CBIM #2J1047A	10123
J102	N17-J-39248-3224	JACK, TELEPHONE: Navy type (-49025B)	Headphone jack	CBIM #C-11	10122
J103		Same as J102	Headphone jack		
J104	N17-C-73501-3590	CONNECTOR, RECEPTACLE: Navy type (4-91952)	Power receptacle	CANS #9901	10188
J105	N17-C-67444-2001	CONNECTOR, ADAPTER; right angle	Attenuator input	CANS #KN-9901	10661
J106		Same as J105	Attenuator output		
J107	N17-C-73108-6064	CONNECTOR, RECEPTACLE: similar to UG-19B/U	160 mc IF INPUT receptacle	CANS #KN-1901	10405
J108	N17-C-73108-1267	RECEPTACLE, CONNECTOR: BNC; AN type UG-290A/U	" SCOPE" jack	CARO #2700	10121
J109 thru J200		Not used			

SYMBOL DESIG.	STANDARD NAVY STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION	MFR. NO.	STODDART NO.
J201		Same as J108	160 mc input connector		
J202		Same as J108	60 mc output connector		
J203 thru J300		Not used			
L101 thru L121		Not used			
L122	N16-C-73088-9362	COIL, RF: Single pi choke	IF filter choke, V110	CADV #10360	10360
L123	N16-C-74529-1251	COIL, RF: Single pi choke	Peaking coil V114 plate	CADV #90481-1	90481-1
L124 thru L199		Not used			
L200		COIL, RF: solenoid, air-wound; 6 tuns #18 tinned copper wire; resonates at 141 mc with 30 mmf capacity	Low pass filter	CADV #10959	10959
L201		Same as L200	Low pass filter		
L202	N16-C-72288-8924	CHOKE, RADIO FREQUENCY: 25 mc resonant frequency	Cathode choke V201	CAUZ #10100-21	10756
L203	N17-T-68382-9460	TRANSFORMER, INTERMEDIATE FREQUENCY: 60 mc, 4 turns primary, 12 turns secondary	60 mc IF output transformer	CADV #91043-1	91043-1
L204	N16-C-72777-1535	COIL, OSCILLATOR TANK: double winding	Oscillator tank coil	CADV #91042-1	91042-1
L205		CHOKE, RADIO FREQUENCY: 0.47 micro-henries	Filament choke V201	CAUZ #10100-27	10758
L206		Same as L205	Filament choke V201		

SYMBOL DESIG.	STANDARD NAVY STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION	MFR. NO.	STODDART NO.
M101	N17-M-29351-6276	METER, MULTI-SCALE, DC: 0-1 microvolts, 0-40 db	Microvolt and db meter	CV #269	10402
P101	N17-C-71408-3168	CONNECTOR, PLUG: 1 male contact; straight; type 'N'	Connects to RF attenuator input	CADV #90399-1	90399-1
P102		Same as P101 (p/o W101)	Connects RF attenuator output		
P103 thru P200		Not used			
P201		CONNECTOR, PLUG: AN type UG-88/U; type BNC	Connects to 160 mc converter	CANS #UG-88/U	10084
P202	N17-C-71408-3425	CONNECTOR, PLUG: AN type UG-260A/U, type BNC	Mixer IF output connector	CARO #3100	10228
P203 thru P300		Not used			
R101 thru R117		Not used			
R118	N16-R-66250-7116	RESISTOR, FIXED: WIRE WOUND: 5000 ohms, 6 w	Plate dropping V201	CAO #RW21E502	10207
R119		Not used			
R120	N16-R-49642-431	RESISTOR, FIXED: COMPOSITION: 1000 ohms, 1/2w	Cathode bias V104	CBZ #EB-1815	10011-331
R121		RESISTOR, FIXED: COMPOSITION, 180,000 ohms, 1/2w	Screen dropping V104	CBZ #EB 1845	10011-184

SYMBOL DESIG.	STANDARD NAVY STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION	MFR. NO.	STODDART NO.
R122	N16-R-49579-431	RESISTOR, FIXED: COMPOSITION: 100 ohms; 1/2 w	B+ decoupling V104	CBZ #EB-1015	10011-101
R123	N16-R-49498-431	RESISTOR, FIXED: COMPOSITION; 68 ohms; 1/2 w	Cathode bias V105	CBZ #EB-6805	10011-680
R124		RESISTOR, FIXED, composition, 120,000 ohms, 1/2w	Screen dropping V105	CBZ #EB-1245	10011-124
R125		Same as R122	B+ decoupling at V105		
R126		Same as R120			
R127 thru R130		Not used			
R131		Same as R122	Cathode bias V105		
R132	N16-R-87679-4540	RESISTOR, VARIABLE: COMPOSITION; 10,000 ohms; 2 w	Attenuator $X10^2$ adjust	CBZ type J	10252
R133	N16-R-50740-751	RESISTOR, FIXED: COMPOSITION; 270,000 ohms; 1 w	Attenuator X10 voltage divider	CBZ #GB-2745	10012-274
R134		Same as R123	Cathode Bias V106		
R135	N16-R-49363-431	RESISTOR, FIXED: COMPOSITION; 33 ohms, 1/2 w	Cathode bias V106	CBZ #EB-3305	10011-330
R136	N16-R-87679-4180	RESISTOR, VARIABLE: COMPOSITION, 10,000 ohms; 2 w	CAL control	CBZ type JU-1031	10408
R137		Same as R133	Voltage divider for CAL control		
R138	N16-R-50479-431	RESISTOR, FIXED, composition, 47,000 ohms, 1/2w	Screen dropping V104	CBZ #EB-4735	10011-473

SYMBOL DESIG.	STANDARD NAVY STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION	MFR. NO.	STODDART NO.
R139		Same as R122	B+ decoupling V106		
R140		Same as R123	Cathode bias V107		
R141 thru R145		Not used			
R146	N16-R-50011-751	RESISTOR, FIXED, COMPOSITION: 2200 ohms, 1 w	Voltage divider for F1-100 control	CBZ #GB-2225	10012-222
R147	N16-R-87419-4350	RESISTOR, VARIABLE, COMPOSITION: 2500 ohms, 2 w	FI-100 control	CBZ type J	10378
R148	N16-R-50480-171	RESISTOR, FIXED, COMPOSITION: 47,000 ohms 2 w	Voltage divider for FI-100 control	COM type "Little Devil"	10377-473
R149	N16-R-50551-431	RESISTOR, FIXED, COMPOSITION: 68,000 ohms 1/2 w	Screen dropping V107	CBZ #EB-6835	10011-683
R150		Same as R122	B+ decoupling at V107		
R151	N16-R-50335-431	RESISTOR, FIXED, COMPOSITION: 15,000 ohms 1/2 w	T105 secondary loading	CBZ #EB-1535	10011-153
R152	N16-R-49660-431	RESISTOR, FIXED, COMPOSITION: 220 ohms; 1/2 w	Cathode bias V108	CBZ #EB-2215	10011-221
R153		Same as R138			
R154		Same as R122	B+decoupling at V108		
R155		Same as R122	B+ decoupling for IF tubes		

SYMBOL DESIG.	STANDARD NAVY STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION	MFR. NO.	STODDART NO.
R156 thru R160		Not used			
R161	N16-R-49804-431	RESISTOR, FIXED, COMPOSITION: 560 ohms, 1/2 w	Cathode bias V109	CBZ#EB-5615	10011-561
R162		Same as R151	T107 primary loading		
R163	N16-R-50398-431	RESISTOR, FIXED, COMPOSITION: 27,000 ohms, 1/2 w	Screen dropping V109	CBZ #EB-2735	10011-273
R164		RESISTOR, FIXED, COMPOSITION: 1000 ohms; 1/2 w	B+ decoupling at V109	CBZ #EB-1025	10011-102
R165		Not used			
R166		Not used			
R167	N16-R-51208-431	RESISTOR, FIXED, COMPOSITION: 5.6 megohms; 1/2 w	Quasi-peak diode load	CBZ #EB-5655	10011-565
R168	N16-R-50821-751	RESISTOR, FIXED, COMPOSITION: 470,000 ohms, 1 w	Voltage divider at V111 cathode	CBZ #GB-4745	10012-474
R169	N16-R-49939-431	RESISTOR, FIXED, COMPOSITION: 1200 ohms; 1/2 w	Cathode bias V111	CBZ #EB-1225	10011-122
R170		Same as R136	PEAK control		
R171 thru R175		Not used			
R176	N16-R-50363-171	RESISTOR, FIXED, COMPOSITION: 20,000 ohms 2 w	Voltage divider at V111 screen	CBZ-HB-2035	10377-203
R177	N16-R-87849-4590	RESISTOR, VARIABLE, COMPOSITION: 50,000 ohms, 2 w	FI-10 control	CBZ type J	10379

SYMBOL DESIG.	STANDARD NAVY STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION	MFR. NO.	STODDART NO.
R178	N16-R-87349-4560	RESISTOR, VARIABLE, COMPOSITION: Navy type (-636059-110) 1000 ohms, 2 w	QP-100 control	CBZ type JLU-1021	10141
R179	N16-R-87519-4570	RESISTOR, VARIABLE, COMPOSITION: 5000 ohms, 2 w	QP-1 control	CBZ type J	10380
R180		Same as R179	PEAK BUCK control		
R181		Same as R179	FI BUCK control		
R182		RESISTOR, FIXED, COMPOSITION: 270,000 ohms, 1 w	B+ dropping for weighting circuits	CBZ #GB-1845	10012-274
R183		Not used			
R184		Not used			
R185	N16-R-49966-431	RESISTOR, FIXED, COMPOSITION: 1500 ohms 1/2 w	External meter compensating at J101	CBZ #EB-1525	10011-152
R186		Same as R164	B+ filter to V114		
R187		Not used			
R188		Not used			
R189	N16-R-49732-431	RESISTOR, FIXED, COMPOSITION: 390 ohms, 1/2 w	Gain equalizing resistor at S102A	CBZ #EB-3915	10011-391
R190		RESISTOR, FIXED, COMPOSITION: 21 ohms, 1/2 w	A+ dropping resistor	CBZ #EB-2105	10011-210
R191		Not used			
R192	N16-R-50164-431	RESISTOR, FIXED, COMPOSITION: 5600 ohms, 1/2 w	VTVM bias	CBZ #EB-5625	10011-562

SYMBOL DESIG.	STANDARD NAVY STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION	MFR. NO.	STODDART NO.
R193	N16-R-49876-431	RESISTOR, FIXED, COMPOSITION: 820 ohms 1/2 w	Cathode bias V112	CBZ #EB-8215	10011-821
R194		Same as R193	Cathode bias V113		
R195	N16-R-50371-431	RESISTOR, FIXED, COMPOSITION: 22,000 ohms, 1/2 w	VTVM bridge	CBZ #EB-2235	10011-223
R196		Same as R132	ADJ ZERO control:		
R197		Same as R195	VTVM bridge		
R198		Same as R147	PEAK-109 control, marked		
R199		Same as R126	Grid return V114		
R200		Same as R189	Cathode bias V114		
R201	N16-R-49687-431	RESISTOR, FIXED, COMPOSITION: 270 ohms, 1/2 w	Cathode bias at V201 (Mixer)	CBZ #EB-2715	10011-271
R202	N16-R-50128-431	RESISTOR, FIXED, COMPOSITION: 4700 ohms, 1/2 w	Grid bias at V201 (oscillator)	CBZ #EB-4725	10011-472
R203		RESISTOR, FIXED, COMPOSITION: 82 ohms, 1/2 w	Input resistor at J201	CBZ #EB-8205	10011-820
R204		RESISTOR, FIXED, COMPOSITIONS: 22 ohms; 1/2 w	Part of 50-ohm pad	CBZ #EB-2205	10011-220
R205		Same as R204	Part of 50-ohm pad		
R206	N16-R-50515-431	RESISTOR, FIXED, COMPOSITION: 56,000 ohms, 1/2 w	Screen dropping V114	CBZ #EB-5635	10011-563
R207		Same as R192	Plate load V114		
R208		Same as R161	Cathode bias V115A		

SYMBOL DESIG.	STANDARD NAVY STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION	MFR. NO.	STODDART NO.
R209		Same as R164	Plate load V115A		
R210		Same as R138	Cathode bias V116		
R211		Same as R164	Cathode bias V115B		
R212		Same as R126	Grid return V115A		
R213	N16-R-88339-4040	RESISTOR, VARIABLE, COMPOSITION: 1 megohm; 2 w	Audio volume control	CBZ type JU-1051	10407
R214	N16-R-50974-431	RESISTOR, FIXED, COMPOSITION: 1 megohm, 1/2 w	Plate load V116	CBZ #EB-1055	10011-105
R215		RESISTOR, FIXED, COMPOSITION: 47 ohms; 1/2 w	Part of 50-ohm pac	CBZ #EB-4705	10011-470
R216 thru R300		Not used			
S101	N17-S-69500-7701	SWITCH, SENSITIVE: SPDT	Attenuator switch	CATK #1MOBD	10387
S102A B, C, D, E	N17-S-66859-7901	SWITCH, ROTARY: 5 sections	Function switch	COC type F	10384
S103A B, C	N17-S-62121-3294	SWITCH, ROTARY: 1 section	Pulse stretcher on-off	COC type F	10385
S104 thru S300		Not used			
T101		Not Used			
T102	N17-T-68400-1018	TRANSFORMER, IF: 60.7 mc; 1st IF	Interstage IF Transformer	CADV #90377-1	90377-1

SYMBOL DESIG.	STANDARD NAVY STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION	MFR. NO.	STODDART NO.
T103	N17-T-68379-1942	TRANSFORMER, IF: 59.3 mc; 2nd IF	Interstage IF Transformer	CADV #90377-2	90377-2
T104	N17-T-68381-9137	TRANSFORMER, IF: 60 mc; 3rd IF	Interstage IF Transformer	CADV #90377-3	90377-3
T105	N17-T-68400-1023	TRANSFORMER, IF: 60.7 mc; 4th IF	Interstage IF Transformer	CADV #90377-4	90377-4
T106		Same as T105 except tuned to 59.3 mc	Interstage IF Transformer		
T107	N17-T-68391-9142	TRANSFORMER, IF: 60 mc; 6th IF	Interstage IF Transformer	CADV #90377-5	90377-5
T108	N17-T-65498-4751	TRANSFORMER, AF: Navy type (-304878);	Audio output	CADV #10128	10128
V101		Not used			
V102		Not used			
V103		Not used			
V104	N16-T-56215-20	TUBE, ELECTRON: JAN type 6BH6	First IF amplifier	CRC #6BH6	CADV 6BH6
V105		Same as V104	Second IF amplifier		
V106		Same as V104	Third IF amplifier		
V107		Same as V104	Fourth IF amplifier		
V108		Same as V104	Fifth IF amplifier		
V109	N16-T-56199-50	TUBE, ELECTRON: JAN-6AR5	Sixth IF amplifier	CRC #6AR5	CADV 6AR5

SYMBOL DESIG.	STANDARD NAVY STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION	MFR. NO.	STODDART NO.
V110		TUBE, ELECTRON: JAN 5726	Detector	CRC #5726	CADV 5726
V111		Same as V104	AVC amplifier		
V112		TUBE, ELECTRON: JAN 6135	VTVM	CRC #6135	CADV 6135
V113		Same as V112	VTVM		
V114		Same as V104	First audio amplifier		
V115		TUBE, ELECTRON: JAN-5814A	Audio amplifier	CRC #5814A	CADV 5814A
V116		Same as V110	Pulse stretcher		
V201		TUBE, ELECTRON: JAN-12AT7WA	Converter	CRC #12AT7WA	CADV 12AT7WA
W101		CABLE ASSEMBLY, INTERMEDIATE FREQUENCY	Connects attenuator output to frequency converter	CADV #91011-1	91011-1
XV101 thru XV103		Not used			
XV104	N16-S-62603-6700	SOCKET, TUBE: 7 contacts, miniature; JAN type #TSE7-T102	Socket for V104	CEB #7676	10118
XV105		Same as XV104	Socket for V105		
XV106		Same as XV104	Socket for V106		
XV107		Same as XV104	Socket for V107		

SYMBOL DESIG.	STANDARD NAVY STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION	MFR. NO.	STODDART NO.
XV108		Same as XV104	Socket for V108		
XV109		Same as XV104	Socket for V109		
XV110		Same as XV104	Socket for V110		
XV111		Same as XV104	Socket for V111		
XV112		Same as XV104	Socket for V112		
XV113		Same as XV104	Socket for V113		
XV114		Same as XV104	Socket for V114		
XV115		SOCKET TUBE: 9 contacts; miniature: JAN type #TSE9-T102	Socket for V115	CMG #53F13381	10036
XV116		Same as XV104	Socket for V116		
Z101 thru Z105		Not used			
Z106	N16-F-44713-1001	FILTER, LOW-PASS: 2.7 mc cutoff frequency	IF filter at V105	CADV #90379-1	90379-1
Z107		Same as Z106	IF filter at V107		
Z108	N16-F-44899-1001	FILTER ASSEMBLY: contains 2 identical low-pass filters	IF filter at V107 grid and cathode	CADV #90380-1	90380-1
Z109		Same as Z106	IF filter at V108 cathode		
Z110	N16-F-44889-5011	FILTER ASSEMBLY: contains 1 band suppression filter and 1 low-pass filter	IF filter for heater and plate supplies to IF tubes	CADV #90381-1	90381-1

SYMBOL DESIG.	STANDARD NAVY STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION	MFR. NO.	STODDART NO.
Z111		Same as Z106	IF filter		
Z112	N16-F-34678-4114	FILTER, BAND SUPPRESSION: suppresses frequencies from 50 to 70 mc	IF filter for AVC filter and diode load	CADV #90382-1	90382-1
Z113	N16-F-34697-4002	FILTER, BAND SUPPRESSION: peak freq 60 mc; band-width 12 mc	Feedback filter V104 heater	CADV #90385-1	90385-1
Z114		Same as Z113	Feedback filter at V105 heater		
Z115		Same as Z113	Feedback filter at V106 heater		
Z116		Same as Z113	Feedback filter at V107 heater		
Z117		Same as Z113	Feedback filter at V108 heater		
Z118		Same as Z113	Feedback filter at V109 heater		

SYMBOL DESIG.	STANDARD NAVY STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION	MFR. NO.	STODDART NO.
		POWER SUPPLY PP-530/URM-17			
C301	N16-C-48841-9535	CAPACITOR, FIXED, PAPER DIELECTRIC: 1.0 mfd; 400 vdcw; JAN type CCP65B1EE105V, spec JAN -C-25	Power supply regulator filter	CD#CP #65B1EE105V	10359
C302	N16-C-20167-9825	CAPACITOR, FIXED, ELECTROLYTIC: 90 mfd; 400 vdcw; JAN #CE41C9000; spec JAN-C-62	Power supply B+ filter	CSF #V7242	10382
C303		Same as C302	Power supply B+ filter		
E301	N17-P-69137-8331	POST, BINDING: screw type	Ground post for power supply	CEB #6604	10171
E302		Same as E104	Shield for V302		
F301	G17-F-16302	FUSE, CARTRIDGE: 2 amps at 250 v; Navy type (-28032-2)	AC line fuse	CLF #AG-31202	10411
F302		Same as F301	AC line fuse		
H301	N16-C-300798-866	CLAMP, TUBE: snapslide type; stainless steel	Clamp for R301	CAIS #926C	10271
H302		CLAMP, TUBE: snapslide type; stainless steel	Clamp for V301	CAIS #926-H4	10698
H303	N17-C-781366-251	CLAMP, CABLE: aluminum; AN-3057-6	Cable clamp on P301	CED #2255-3	10096
I301	G17-L-6297	LAMP, INCANDESCENT: 6-8 v, 0.15 amp; Sig C LM-52	Pilot lamp	CG #GE-47	10051
J301	N17-C-73209-3387	CONNECTOR, RECEPTACLE: Navy type (-491954)	Power output receptacle	CED #02AR-14S -5S	10189

SYMBOL DESIG.	STANDARD NAVY STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION	MFR. NO.	STODDART NO.
J302	N17-C-73462-1624	CONNECTOR, RECEPTACLE: Navy type (-491953)	Power input receptacle	CED #02AR-14S-7P	10187
R301	N16-R-85001-1511	RESISTOR, THERMAL: 3.4 to 5.1 v at 3.4 to 3.6 amp; ST-14 bulb	Current limiter	CAGK #34-2	10355
R302	N16-R-49255-431	RESISTOR, FIXED, COMPOSITION: 12 ohms, 1/2 w	1301 current limiter	CBZ #EB-1205	10011-120
R303		Not used			
R304	N16-R-50587-431	RESISTOR, FIXED, COMPOSITION: 82,000 ohms 1/2 w	Plate load of V302	CBZ #EB-8235	10011-823
R305	N16-R-50416-431	RESISTOR, FIXED, COMPOSITION: 33,000 ohms 1/2 w	Voltage divider, V302 screen supply	CBZ #EB-3355	10011-333
R306		Same as R163	Voltage divider, V302 screen supply		
R307	N16-R-50308-431	RESISTOR, FIXED, COMPOSITION: 12,000 ohms, 1/2 w	Voltage divider, V302 grid bias	CBZ #EB-1235	10011-123
R308		Same as R179	REGULATOR ADJ		
R309	N16-R-50443-751	RESISTOR, FIXED, COMPOSITION: 39,000 ohms, 1 w	Voltage divider, V302 grid bias	CBZ #GB-393J	10012-393
R310	N16-R-49706-121	RESISTOR, FIXED, COMPOSITION: 330 ohms, 2 w	Filter resistor	COM "Little Devil"	10377-331
R311		Same as R310	Filter resistor		
R312		Same as R310	Filter resistor		
R313		Same as R310	Filter resistor		

SYMBOL DESIG.	STANDARD NAVY STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION	MFR. NO.	STODDART NO.
R314		Same as R121	Current divider V302		
S301	N17-S-74049-5902	SWITCH, TOGGLE: Navy type (-24003); DPDT	POWER ON-OFF	CHH #20905GH	10172
S302		Same as S301	Power input selector		
T301	N17-T-74421-2551	TRANSFORMER, POWER: filament and plate type	Power transformer	CBGM #4826	10386
V301		TUBE, ELECTRON: JAN-6080WA	Rectifier regulator	CRC #6080WA	CADV #6080WA
V302		Same as V104	Regulator control		
V303	N17-L-6811-62	LAMP, GLOW: JAN type #NE-32; 105-125 v, 1w	Bias regulator	CG#NE-32	10434
XF301		HOLDER, FUSE: for 3 AG cartridge fuse	Fuse holder, F301	CADV #10331	10331
XF302		Same as XF301	Fuse holder, F302		
XF303		Same as XF301	Holder for spare fuse		
XF304		Same as XF301	Holder for spare fuse		
XI301	N17-L-76854-4015	SOCKET ASSEMBLY, INDICATOR LIGHT: red lens	Socket for I301	CAYS #40	10115

SYMBOL DESIG.	STANDARD NAVY STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION	MFR. NO.	STODDART NO.
XV301		SOCKET, TUBE: Navy type (-49395); 8 contact octal	Socket for V301	CMG #9857	10197
XV302		Same as XV104	Socket for V302		
XV303		Same as XV301	Socket for R301		
XV304	N17-L-51709-5500	LAMPHOLDER: bayonet base	Socket for V303	CJA #3391	10119
Z301	N16-F-44000-1016	FILTER ASSEMBLY: low pass pi network type	RF filter, power input	CADV #90386-1	90386-1

SYMBOL DESIG.	STANDARD NAVY STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION	MFR. NO.	STODDART NO.
		POWER SUPPLY PP-1179/URM-42			
C401	N16-C-49960-8637	CAPACITOR, FIXED, PAPER DIELECTRIC: 4.0 mmf; 1000 vdcw	-650 volt filter	CD #TJH-10040	10749
C402	N16-C-33623-3170	CAPACITOR, FIXED, MICA DIELECTRIC: 0.01 mfd; 1200 vdcw	Cathode by-pass V402	CD #4L-21010	10748
C403	N16-C-45773-9202	CAPACITOR, FIXED, PAPER DIELECTRIC: 0.1 mfd; 400 vdcw	Grid by-pass V406	CAW #416CT	10747
C404	N16-C-19544-3414	CAPACITOR, FIXED, ELECTROLYTIC: 8.0 mdf; 475 vdcw	-105 volt filter	CAW type GG-E13A13	10750
C405		Same as C166	Plate by-pass V410		
C406	N16-C-48825-2698	CAPACITOR, FIXED, PAPER DIELECTRIC: 1.0 mfd; 2500 vdcw	-1610 volt filter	CD #TJH-25010	10751
C407	N16-C-49204-6023	CAPACITOR, FIXED, PAPER DIELECTRIC: 2 mfd: 2000 vdcw	-1610 volt filter	CD #TJH-20020	10752
C408		CAPACITOR, FIXED, PAPER DIELECTRIC: 2 mfd; 2000 vdcw	-650 volt filter	CD #TJO 20010J	10626
E401		Same as E109	Shield for V401		
E402		Same as E104	Shield for V402		
E403 thru E405		Not used			
E406		Same as E104	Shield for V406		
E407 thru E409		Not used			

SYMBOL DESIG.	STANDARD NAVY STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION	MFR. NO.	STODDART NO.
E410		Same as E104	Shield for V410		
F401	G17-F-16302-90	FUSE, CARTRIDGE: 1.5 amps 250 V	Primary T401	CFA #CLF	10208
F402	G17-F-16298-30	FUSE, CARTRIDGE: 1.0 amps; 250 V	Primary T402	CFA #AGC	10739
F403		Same as F401	Primary T403		
F404	G17-F-16302-80	FUSE, CARTRIDGE: 0.5 amps 250 V	Primary RF Tuner Filament Transformers	CFA #AGC	10740
H401		CLAMP, TUBE: Snapslide type; stainless steel	Clamp for V409	CAIS Special	30879
I401		Same as I301	Power Supply "ON" Indicator		
J401		Same as J302	AC Power Input Connector 105-130 volts 50-400 cycles		
J402		CONNECTOR, RECEPTACLE: female; 15 round contacts	Power cable connector output	Winchester #202B	91053-1
J403		Same as J102	Crystal current connector		
J404	N17-C-73200-1973	CONNECTOR, RECEPTACLE: 4 contacts; female	AC power connector for Im-103/URM-42 and SG-112/URM	CYD #4832	10047
J405	N17-C-73139-7587	CONNECTOR, RECEPTACLE: 2 rectangular female contacts	AC power accessory connector (recorder)	CHP #974085	10156

SYMBOL DESIG.	STANDARD NAVY STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION	MFR. NO.	STODDART NO.
L401	N16-R-29235-5751	REACTOR, FILTER CHOKE: 10 hy; 0.075 amp	Filter V404, V405	CBGM #6026	10764
L402		Same as L401	Filter V408		
L403	N16-R-29448-4101	REACTOR, FILTER CHOKE: 30 hy; 0.040 amp	Filter, V411, V412, V413, V414	CBGM #6027	10765
R401		Same as R176	Load resistor V401		
R402		Same as R214	Plate resistor V402		
R403	N16-R-50632-431	RESISTOR, FIXED, COMPOSITION: 100,000 ohms; 1/2 w	Screen resistor V402	CBZ-EB-1045	10011-104
R404	N16-R-50408-171	RESISTOR, FIXED, COMPOSITION: 33,000 ohms, 2w	Voltage divider V202	CBZ- #HB-3335	10377-333
R405	N16-R-87749-4560	RESISTOR, VARIABLE, COMPOSITION: 25,000 ohms; 2 w	Adjust -650 VDC	CBZ type J	10144
R406		RESISTOR, FIXED, COMPOSITION: 20,000 ohms; 1/2 w	Voltage divider V202	CBZ-EB-2035	10011-203
R407		RESISTOR, FIXED, WIRE WOUND: 25,000 ohms, 50 watt, ±5%	Limiting resistor for V401	Dale RH-50	10780-253
R408	N16-R-50633-171	RESISTOR, FIXED, COMPOSITION: 100,000 ohms; 2 w	Voltage divider V202	CBZ-HB-1045	10377-104
R409		Same as R214	Plate resistor V406		
R410		Same as R121	Screen resistor V406		
R411	N16-R-50515-950	RESISTOR, FIXED, COMPOSITION: 56,000 ohms; 2 w	Grid divider V406	CBZ-HB-5635	10377-563

SYMBOL DESIG.	STANDARD NAVY STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION	MFR. NO.	STODDART NO.
R412		Same as R411	Grid divider V406		
R413	N16-R-50335-940	RESISTOR, FIXED, COMPOSITION: 150,000 ohms; 2 w	Voltage divider V410	CBZ-HB-1545	10377-154
R414		Not used			
R415		Not used			
R416		Same as R405	Adjust -1610 VDC		
R417		RESISTOR, FIXED, WIRE WOUND: 50,000 ohms, 50 watts	Voltage divider V410	Dale RH-50	10780-503
R418		Same as R417	Voltage divider V410		
R419		Same as R417	Voltage divider V410		
R420		Same as R214	Plate resistor V410		
R421		Same as R403	Crystal meter shunt	CBZ-EB-2015	10011-201
R422		Same as R404	Screen dropping V409		
R423		Same as R404	Screen dropping V409		
R424		RESISTOR, FIXED, COMPOSITION: 200 ohms, 1/2 w	Crystal meter shunt	CBZ-EB-2015	10011-201
R425		Same as R147	160 mc IF atten. control		
R426		Same as R302	Limit resistor for I401		

SYMBOL DESIG.	STANDARD NAVY STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION	MFR. NO.	STODDART NO.
R427		Same as R404	Screen dropping V409		
RT401	N17-A-85408-7001	RESISTOR, THYRITE: 560 v ±28% at 0.01 amp; 10 w	Voltage regulator at V403	CG #6851919G-1	10770
RT402		Same as RT401	Voltage regulator at V409		
RT403		Same as RT401	Voltage regulator at V409		
RT404	N17-A-85405-7251	RESISTOR, THYRITE: 200 v ±40% at .001 amps; 1/2 w	Voltage regulator at V409	CG #8355083G-1	10736
S401	N17-S-70653-7901	SWITCH, TOGGLE: single pole, single throw	AC power switch	CAXD #1296	10019
T401	N17-T-74260-6731	TRANSFORMER, POWER	Power transformer	CBGM #6023	10767
T402	N17-T-74224-3501	TRANSFORMER, POWER	Power transformer	CBGM #6024	10768
T403	N17-T-74295-8856	TRANSFORMER, POWER	Power transformer	CBGM #6211	10769
V401		TUBE, ELECTRON: JAN type OA2WA	Voltage regulator	CRC #OA2WA	0A2WA
V402		TUBE, ELECTRON: JAN type 6AU6WA	Voltage regulator	CRC #6AU6WA	6AU6WA
V403	N16-T-56204	TUBE, ELECTRON: JAN type 6B4G	Voltage regulator	CRC#6B4G	6B4G

SYMBOL DESIG.	STANDARD NAVY STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION	MFR. NO.	STODDART NO.
V404	N16-T-53224-10	TUBE, ELECTRON: JAN type 3B24W	Rectifier	CRC #3B24W	3B24W
V405		Same as V404	Rectifier		
V406		Same as V402	Voltage regulator		
V407		Same as V301	Voltage regulator		
V408		TUBE, ELECTRON: JAN type 5R4WGB	Rectifier	CRC #5R4WGB	5R4WGB
V409		TUBE, ELECTRON: JAN type 5933WA	Voltage regulator	CRC #5933WA	5933WA
V410		Same as V402	Voltage regulator		
V411		Same as V404	Rectifier		
V412		Same as V404	Rectifier		
V413		Same as V404	Rectifier		
V414		Same as V404	Rectifier		
XF401		Same as XF301	Fuse holder for F401		
XF402		Same as XF301	Fuse holder for F402		
XF403		Same as XF301	Fuse holder for F403		
XF404		Same as XF301	Fuse holder for F404		

SYMBOL DESIG.	STANDARD NAVY STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION	MFR. NO.	STODDART NO.
XF405		Same as XF301	Holder for spare fuse		
XF406		Same as XF301	Holder for spare fuse		
XF407		Same as XF301	Holder for spare fuse		
XF408		Same as XF301	Holder for spare fuse		
XI401		Same as XI301	Socket for I401		
XV401		Same as XV104	Tube socket for V401		
XV402		Same as XV104	Tube socket for V402		
XV403		Same as XV301	Socket for V403		
XV404	N16-S-60841-4251	SOCKET, TUBE: 4 female contacts; medium	Tube socket for V404	CPH #S49-SS4	10759
XV405		Same as XV404	Tube socket for V405		
XV406		Same as XV104	Tube socket for V406		
XV407		Same as XV301	Tube socket for V407		
XV408		Same as XV301	Tube socket for V408		

SYMBOL DESIG.	STANDARD NAVY STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION	MFR. NO.	STODDART NO.
XV409	For replacement use N16-S-61717-4641	SOCKET, TUBE: 5 female contacts; medium	Tube socket for V409	CPH #77-MIP-5T	10760
XV410		Same as XV104	Tube socket for V410		
XV411		Same as XV404	Tube socket for V411		
XV412		Same as XV404	Tube socket for V412		
XV413		Same as XV404	Tube socket for V413		
XV414		Same as XV404	Tube socket for V414		

SYMBOL DESIG.	STANDARD NAVY STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION	MFR. NO.	STODDART NO.
		GENERATOR, INTERFERENCE SG-112/URM			
C501A C501B		CAPACITOR, FIXED, ELECTROLYTIC: 10/10 mfd; 450 vdcw	B+ filter capacitor	CAW # G-EP	10754
C502		Same as C164	RF filter capacitor		
C503		Same as C119 (p/o J101)	RF filter capacitor		
C504		Same as C119 (p/o J101)	RF filter capacitor		
C505		Not used			
C506		CAPACITOR, FIXED, CERAMIC DIELECTRIC: 0.02 mf; 600 vdcw	Coupling capacitor V504	CAMD #615G223906	10733
C507		Same as C106	Coupling capacitor V504		
C508	For replacement use N16-C-29718-7276	CAPACITOR, FIXED, MICA DIELECTRIC: 330 mmf, ±10%, 500 vdcw	Heater voltage coupling, V504	CD #5W5T33	10010-331
C509		Not used			
C510		Same as C119 (p/o Z101)	Z501 RF filter capacitor		
E501		Same as E109	Tube shield for V501		
E502		Same as E109	Tube shield for V502		
E503		Same as E109	Tube shield for V503		
E504		Same as E115	Tube shield for V504		
E505		Same as E122	Pulse off-on knob		

SYMBOL DESIG.	STANDARD NAVY STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION	MFR. NO.	STODDART NO.
F501		Same as F404	Fuse for T501		
F502		Same as F404	Fuse for T501		
I501		Same as I301	Power ON Lamp		
I502		Same as I301	Indicates positive pulse		
I503		Same as I301	Indicates negative pulse		
J501		CONNECTOR, RECEPTACLE	Power connector	CED #AN-3102-14S-1P modified	91021-1
J502	N17-C-73108-6007	CONNECTOR, RECEPTACLE: type "N" (p/o Z101)	Noise output connector	CADV #91010-1	91010-1
L501	N16-R-29234-8272	REACTOR, FILTER CHOKE: 10 hy; 60 ma	B+ Filter choke	CBGM #6755	10766
L502A	N17-C-60919-3608	COIL, RELAY: 6300 ohms; DC; 115 v	Impulse noise line coil	CATM #850	10703
L502B		Same as L102A (p/o Z101)	Impulse noise line coil		
R501	N16-R-49624-431	RESISTOR, FIXED, COMPOSITION: 150 ohms; 1 w	B+ filter resistor	CBZ #GB-1515	10012-151
R502	N16-R-61882-9815	RESISTOR, FIXED, WIRE WOUND: 3000 ohms; 25 w	B+ filter resistor	Dale RH-25	10705-302

SYMBOL DESIG.	STANDARD NAVY STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION	MFR. NO.	STODDART NO.
R503		Not used			
R504		Same as R302	Dropping resistor for L502 and L503		
R505		Same as R302	Dropping resistor for I501		
R506		Not used			
R507	N16-R-50353-431	RESISTOR, FIXED, COMPOSITION: 18,000 ohms 1/2 w	Plate load resistor for V504	CBZ-EB-1835	10011-183
R508		Same as R507	Plate load resistor for V504		
R509		Not used			
R510	N16-R-51109-431	RESISTOR, FIXED, COMPOSITION: 3.3 megohms; 1/2 w	Grid return r esistor for V504	CBZ-EB-3355	10011-335
R511		Same as R510	Grid return resistor for V504		
R512	N16-R-51325-431	RESISTOR, FIXED, COMPOSITION: 10 megohms; 1/2 w	Noise generator RF filter resistor	CBZ-EB--1065	10011-106
R513		RESISTOR, FIXED: metallic film type; 10 ohms; 1 w: disc	Impulse noise line discharge load resistor	CADV #10643	10643
R514		RESISTOR, FIXED, metallic film type; 39.6 ohms; 1 w	Impedance matching impulse noise line	CADV #10642	10642
S501		Same as S301	Power on-off switch		

SYMBOL DESIG.	STANDARD NAVY STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION	MFR. NO.	STODDART NO.
S502	N17-S-66617-5501	SWITCH, ROTARY: 4 sections; 2 positions	Pulse on-off switch	CADV #10775	10775
T501	N17-T-72414-7901	TRANSFORMER, POWER: 1 primary winding 3 secondary windings; 9 terminals	Power transformer	CBGM #6217	10715
V501	N16-T-56840	TUBE, ELECTRON: JAN type 6 x 4	Full-wave rectifier	CRC #6 x 4	6X4
V502		TUBE, ELECTRON: JAN type OB2WA	Voltage regulator	CRC #OB2WA	OB2WA
V503		Same as V502	Voltage regulator		
V504		Same as V115	PRF generator		
XF501		Same as XF301	Fuse socket for F501		
XF502		Same as XF301	Fuse socket for F502		
XF503		Same as XF301	Fuse socket for spare fuse		
XF504		Same as XF301	Fuse socket for spare fuse		
XI501		Same as XI301	Lamp socket for I501		
XI502		Same as XI301	Lamp socket for I502		

SYMBOL DESIG.	STANDARD NAVY STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION	MFR. NO.	STODDART NO.
XI503	N17-L-76948-1502	LIGHT, INDICATOR: with 1/2 in. dia green diamond cut lens	Lamp socket	CAYS #40 with hole added to bracket	10777
XV501		Same as XV104	Tube socket for V501		
XV502		Same as XV104	Tube socket for V502		
XV503		Same as XV104	Tube socket for V503		
XV504		Same as XV115	Tube socket for V504		
Z501	Assemble from component parts	LINE, COAXIAL, IMPULSE NOISE GENERATOR	Impulse noise line	CADV #90857-2	90857-2

SYMBOL DESIG.	STANDARD NAVY STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION	MFR. NO.	STODDART NO.
		SWITCH, COAXIAL SA-352/U			
S601	N16-T-25471-1010	SWITCH, COAXIAL: 52 ohms nominal impedance; single pole, four throw: Navy type SA-352/V	RF input selector	Transco #M1460-4	10741

UNCLASSIFIED

ORIGINAL

SYMBOL DESIG.	STANDARD NAVY STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION	MFR. NO.	STODDART NO.
		ANTENNA ASSEMBLIES			
E701	N16-A-46983-7336	ANTENNA: Army-Navy type AT-522/URM-42; includes mast mounting rod and stiffner plate	300 to 3000 mc antenna		91029-1
E801		ANTENNA, CONE: Army-Navy type AT-570/URM-42	1000 to 10,000 mc antenna	CADV #90794-1	90794-1
O801		HOLDER, ANTENNA: Army-Navy type AB-413/URM-42	Supports AT-570/URM-42 antenna	CADV #90795-1	90795-1

SYMBOL DESIG.	STANDARD NAVY STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION	MFR. NO.	STODDART NO.
		CABLE ASSEMBLIES			
E1101		Not used			
E1102		Not used			
E1103	N17-C-802585-161	CLIP, ALLIGATOR: steel, galvanized	Ground clip for W1105	CBIT #60HS	10086
P1101		CONNECTOR, PLUG: Army-Navy AN3106-3 6(102) plug, modified insert: p/o W1104	W1104 connector		
P1102		CONNECTOR, PLUG: Army-Navy UG-260/U: p/o W1106	W1106 connector	CADV #10084	10084
P1103		CONNECTOR, PLUG: Army-Navy UG-21D/U: p/o W1109	W1109 connector	CARO #90000	10701
P1104		Same as P1103	W1109 connector		
P1105		Same as P1103 (p/o W1107)	W1107 connector		
P1106		Same as P1103 (p/o W1108)	W1108 connector		
P1107		Same as P1103 (p/o W1107)	W1107 connector		
P1108		CONNECTOR, PLUG: Army-Navy type UG-536/U	W1106 connector	CARO #34000	10478
P1109	N17-C-71211-5560	CONNECTOR, PLUG: Navy type (-491971) 5 round female contacts; p/o W1105	W1105 connector	CED #06AR-14S-5S	10192
P1110	N17-C-71501-9111	CONNECTOR, PLUG: Navy type (-49172) 5 round male contacts	W1105 connector	CED #06AR-14S-5P	10193

SYMBOL DESIG.	STANDARD NAVY STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION	MFR. NO.	STODDART NO.
P1111	N17-C-70328-1515	CONNECTOR, PLUG: Army-Navy type # AN-3106-14S-7S; 3 round female contacts	W1102 connector	CED #2075-10	10094
P1112		Same as P1111 (p/o W1103)	W1103 connector		
P1113		CONNECTOR, PLUG: Navy type (-491969) 2 flat parallel male blades; p/o W1103	W1103 connector	CADV #10083	10083
P1114		CONNECTOR, PLUG	W1104 connector	CADV #91081-1	91081-1
P1115		Same as P1104 (p/o W1108)	W1108 connector		
P1116		Same as P1111 (p/o W1101)	W1101 connector		
P1117		Same as P1113 (p/o W1101)	W1101 connector		
P1118		Same as P1113 (p/o W1102)	W1102 connector		
P1119		Same as P1104 (p/o W1110)	W1110 connector		
P1120		Same as P1104 (p/o W1110)	W1110 connector		
W1101	N17-C-48293-9599	CABLE ASSEMBLY, POWER: Army-Navy type Power Cable Assembly: CADV-62480(6'0")	AC Power Cable, PP-530/URM-17 power supply	CADV #90072-1	90072-1
W1102		Same as W1101	AC Power Cable, RF unit power supply		
W1103		Same as W1101	AC Power Cable, impulse noise generator		
W1104	N17-C-48526-1565	CABLE ASSEMBLY, POWER: Army-Navy type CX-2967/U(6'0") lg overall: 8 insulated wires in vinylite tubing	RF unit-power supply cable	CADV #90824-1	90824-1

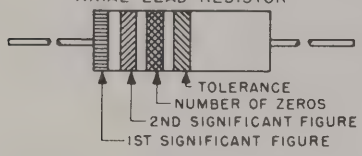
SYMBOL DESIG.	STANDARD NAVY STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION	MFR. NO.	STODDART NO.
W1105	N17-C-48703-5521	CABLE ASSEMBLY, SPECIAL PURPOSE: Army-Navy type Special Purpose Cable Assembly CADV-62481(10'0")	Connects IM-103/URM-42 to power supply	CADV #90082-1	90082-1
W1106		CABLE ASSEMBLY, IF: Army-Navy type CG-1264/U	Connects IF output to IM-103/URM-42	CADV #90811-1	90811-1
W1107		CABLE ASSEMBLY, RF: Army-Navy RF Cable Assembly	RF input cable	CG-92D/U (20'0")	90933-1
W1108		CABLE ASSEMBLY, RF: Army-Navy RF Cable Assembly	Noise generator output cable	CG-92D/U (3'0")	90933-2
W1109		Same as W1108 except for cable tab and CADV number	Connects input coaxial switch to R-F Tuner	CADV #90933-4	90933-4
W1110		CABLE ASSEMBLY, RF: Army-Navy type CG-92D/U(6'0")	RF input cable (short)	CADV #90933-3	90933-3

SYMBOL DESIG.	STANDARD NAVY STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION	MFR. NO.	STODDART NO.
		ACCESSORIES			
A1301	*	CASE, RADIO INTERFERENCE MEASURING SET, CY-1648/URM-42	Transit case for principal equipment	CADV #90814-1	90814-1
A1302	*	CASE, ACCESSORIES, CY-1650/URM-42	Transit case for Power supplies and accessories	CADV #91075-1	91075-1
A1303	*	CASE, TUNER, CY-1649/URM-42	Transit case for RF Tuners	CADV #90826-1	90826-1
A1304		Not used			
A1305	N16-B-110001-105	BAG, TRIPOD: olive drab canvas	Tripod case	CADV #90407-1	90407-1
A1306	N16-T-802001-107	TRIPOD: Navy type (-10545); for dipole antenna	Dipole antenna support	CADV #90310-1	90310-1
A1307	F16-M-155273-434	MAST SECTION, ANTENNA SUPPORT	Antenna mast	CADV #90318-1	90318-1
A1308	*	INDICATOR, AZIMUTH	Indicator for antenna orientation	CADV #90044-1	90044-1
A1309	*	POINTER AZIMUTH DIAL	Indicates orientation of antenna	CADV #90045-1	90045-1
N1301	N16-C-260021-0177	CHART SET: calibration	Calibration chart set	CADV #91069-1	91069-1
	* = Low Failure item.	If required requisition ESO referencing NavShips 900,180A			

Table 6-1, Applicable Color Codes and Miscellaneous Data

COLOR CODE FOR JAN FIXED RESISTORS VALUES IN OHMS

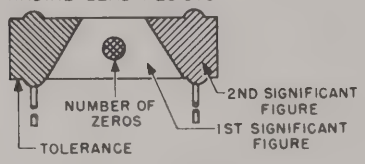
AXIAL LEAD RESISTOR



RESISTOR WITH AXIAL WIRE LEADS

COLOR	1ST BAND	2ND BAND	3RD BAND	END BAND
	VALUE	VALUE	VALUE	TOLERANCE
Black	0	0	None	Gold
Brown	1	1	0	±5%
Red	2	2	00	
Orange	3	3	000	Silver
Yellow	4	4	0000	±10%
Green	5	5	00000	
Blue	6	6	000000	None
Violet	7	7	0000000	±20%
Gray	8	8	00000000	
White	9	9	000000000	

RADIAL LEAD RESISTOR

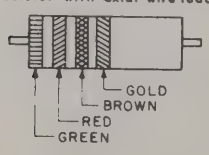


RESISTOR WITH RADIAL WIRE LEADS

COLOR	BODY	END BAND	DOT	END BAND
	VALUE	VALUE	VALUE	TOLERANCE
Black	0	0	None	Gold
Brown	1	1	0	± 5%
Red	2	2	00	
Orange	3	3	000	
Yellow	4	4	0000	Silver
Green	5	5	00000	±10%
Blue	6	6	000000	
Violet	7	7	0000000	
Gray	8	8	00000000	None
White	9	9	000000000	±20%

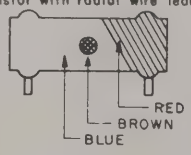
EXAMPLES:

Resistor with axial wire leads



THE RESISTANCE OF THIS RESISTOR IS 520 OHMS ±5%

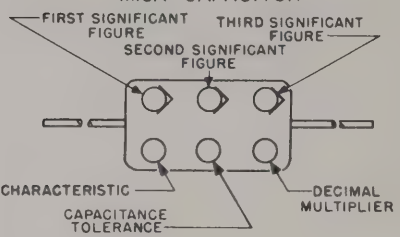
Resistor with radial wire leads



THE RESISTANCE OF THIS RESISTOR IS 620 OHMS ± 20%

COLOR CODE FOR JAN FIXED CAPACITORS VALUES IN MMF

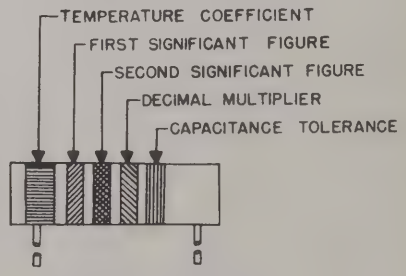
MICA CAPACITOR



MICA CAPACITOR

COLOR	CAPACITANCE		TOLERANCE	CHARACTERISTICS
	SIGNIFICANT FIGURES	DECIMAL MULTIPLIER		
Black	0	1	±20 per cent (M)	A
Brown	1	10		B
Red	2	100	±2 per cent (G)	C
Orange	3	1000		D
Yellow	4			E
Green	5			F
Blue	6			G
Violet	7			
Gray	8			
White	9			
Gold		0.1	±5 per cent (J)	
Silver		0.01	±10 per cent (K)	

CERAMIC CAPACITOR



CERAMIC CAPACITOR

COLOR	CAPACITANCE		TOLERANCE		CHARACTERISTICS *
	SIGNIFICANT FIGURES	DECIMAL MULTIPLIER	CAPACITANCES OF MORE THAN 10 μμf (IN %)	CAPACITANCES OF 10 μμf OR LESS (IN μμf)	
Black	0	1	±20 (M)	2.0 (G)	C–
Brown	1	10	1 (F)		H–
Red	2	100	±2 (G)		L–
Orange	3	1000	—		P–
Yellow	4		—		R–
Green	5		5 (J)	0.5 (D)	S–
Blue	6		—	—	T–
Violet	7		—	—	U–
Gray	8	0.01	—	0.25 (C)	B–
White	9	0.1	10 (K)	1.0 (F)	SL–
Gold					A–

* The significance of these letters will be found in the Joint Army–Navy Specification JAN C-5.

Table 6-2, List of Manufacturers

Designation	Manufacturer, Address
CADV	Stoddart Aircraft Radio Co. Inc., 6644 Santa Monica Blvd., Hollywood 38, California
CAG	General Radio Co., 30 State Street Cambridge, Massachusetts
CAGK	Amperite Company, 561 Broadway, New York, New York
CAHW	Croname, Inc., 3701 Ravenswood Ave., Chicago, Illinois
CAIS	The Birtcher Corp., 5087 Huntington Drive Los Angeles 32, California
CAMD	GoodAll Electric Mfg. Co., Ogallala, Nebraska
CAN	Sangamo Electric Co., 11th and Converse Streets Springfield, Illinois
CANS	Kings Electonics, Inc., 372 Classon Avenue Brooklyn 5, New York
CAO	Ward Leonard Co., #6 South Street Mt. Vernon, New York
CARO	Industrial Products Co., Brookfield Street Danbury, Connecticut
CASU	Electrical Reactance Corp., Franklinville, New York
CATD	Fansteel Metallurgical Corp., Chicago, Illinois
CATK	Acro Electro Co., 1305 Superior Avenue Cleveland, Ohio
CATM	Advance Elctric Co., 1260 West 2nd Street Los Angeles, California
CAUP	Kurz-Kasch, Inc., 1421 South Broadway, Dayton, Ohio
CAUZ	Jeffers Electronics Corp., Dubois, Pennsylvania
CAW	Aerovox Wireless Corp., 742 Belleville Avenue New Bedford, Massachusetts
CAXD	Insuline Corp. of America 30-30 Northern Blvd., Long Island City, New York
CAYS	Drake Manufacturing Co., 1713 West Hubbard Street Chicago, Illinois
CBIM	Switchcraft Co. Inc., 1328-30 North Halsted Street Chicago, Illinois
CBIT	Mueller Electric Co., 1597 East 31st Street Cleveland, Ohio
CBN	Central Radio Laboratory, Division of Globe Union, 90 East Keefe Avenue Milwaukee, Wisconsin
CBZ	Allen-Bradley Co., 118 West Greenfield Avenue Milwaukee, Wisconsin
CD	Cornell-Dubilier Corp., 1000 Hamilton Blvd., South Plainfield, New Jersey
CEB	Hugh H. Eby, Inc., 4700 Stenton Avenue Philadelphia, Pennsylvania
CED	Cannon Electric Development Co., 3291 Humboldt Street Los Angeles 31, California
CER	Erie Resistor Corp., 644 West 12th Street Erie, Pennsylvania

Table 6-2, List of Manufacturers (Cont'd)

Designation	Manufacturer, Address
CFA	Bussman Manufacturing Co., 253 West University Street St. Louis, Missouri
CG	General Electric Co., 1 River Road Schenectady 5, New York
CHH	Arrow Hart and Hedgeman Electric Company 102 Hawthorne Street Hartford, Connecticut
CHP	Haydon Manufacturing Co., Inc., Forestville, Connecticut
CIF	Industrial Instruments, Inc., 156 Culver Avenue Jersey City, New Jersey
CJA	James Millen Mfg. Co. Inc., 150 Exchange Street Malden, Massachusetts
CMG	Cinch Manufacturing Co., 2339 West Van Buren Street Chicago, Illinois
COM	Ohmite Manufacturing Co., 4835 West Flournoy Street Chicago, Illinois
CPH	American Phenolic Corp., 1830 South 54th Avenue Chicago, Illinois
CRC	RCA Manufacturing Co., Radiotron Division Harrison, New Jersey
CSF	Sprague Electric Co., North Adams, Massachusetts
CV	Weston Electrical Instrument Corp. 619 Frelinghuysen Avenue Newark, New Jersey
CYD	Bryant Electric Co., 1421 State Street Bridgeport 2, Connecticut
DMC	Chicago Die Mold Mfg., Co., 4001 Wrightwood Avenue Chicago, Illinois
	Dale Products, Inc., Columbus, Nebraska
	Transco Products, Inc., 12210 Nebraska Avenue Los Angeles 25, California
	Winchester Electronics Inc., 15 Crescent Street Glenbrook, Connecticut

AN/URM-42 ERRATA

Refer to Page 4-3, Table 4-1, left-hand portion of Table, next to the last line. "2 position" should be changed to read "2 and 3 position." Delete the number "3" from the line immediately below.

Refer to Page 5-1, right-hand column, paragraph headed "3. Removal of Chassis From Instrument Cases," sub-paragraph "d. RI-FI Meter" (near the bottom of the page and continuing onto page 5-2). Replace instructions given in that sub-paragraph with the following:

The RI-FI meter may be removed from its case by following these steps:

1. Remove the RF tuner from its shockmount. This is accomplished by loosening the two wing nuts securing the tuner to the shockmount and sliding the tuner forward.

2. Detach the instruction book compartment by removing the three 10-32 machine screws which secure this compartment to the case. Two of these screws are located on the back of the case and one on the right side of the case near the rear, with the operator facing the equipment.

3. Remove the four wood screws from the cable holder mounting board. This board is located in the rear portion of the case, extending from the tuner shockmount to the left side of the case. Remove the board by grasping the round plastic cable holder and raising at that end first to allow the board to clear the shockmount flange.

4. Remove the screws in the center of the four rubber feet on the back of the RI-FI meter case.

5. Slide the RI-FI meter forward from its case.